State of Environment and Outlook Report for the occupied Palestinian territory 2020

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Foreword

The United Nations Environment Programme (UNEP) has produced this report on the State of the Environment in the occupied Palestinian territory in response to a request from the Palestinian Environment Quality Authority. The analysis was generated by a team of international experts, who conducted extensive field visits and consultations in the region during 2018–2019; in this work, they were supported by thematic and regional experts at UNEP headquarters and in relevant regional offices. The team's work was also informed by earlier reports and analyses conducted by UNEP.

During this period of global environmental change, all states and societies must intensify efforts to protect the environment. The challenges of environmental protection and governance are greatest in contexts affected by conflict and crisis, where planning is difficult and governance mechanisms are contested. Yet, as we see clearly in this report, postponing action to protect the environment inevitably leads to damage that affects both current and future generations. We cannot afford to wait.

Some of the environmental issues described in this report have been flagged by UNEP before, but remain unaddressed. A decade ago, UNEP issued a warning about over-abstraction and pollution of the Coastal Aquifer, upon which the people of Gaza rely for drinking water and agriculture. The Coastal Aquifer groundwater is now more than 10 metres below mean sea level and is affected by severe pollution and salinity. In the absence of effective environmental management, groundwater extractions continue at a rate far higher than the annual safe yield.

The report also describes emerging drivers of environmental degradation, including illegal dumping and treatment of electronic waste. The uncontrolled treatment of e-waste releases carcinogens, affecting people on both sides of the Green Line. Palestinian, Israeli and international entities need to intensify efforts to address such serious causes of pollution.

Climate change is exacerbating many of the challenges identified in this report, including water scarcity, degradation of land and soil, and disaster risks. In a context of changing weather patterns and increased aridity, investing in environmental protection and management will become increasingly vital.

To protect people and the environment, it is now critical to put in place sound environmental management practices across the occupied Palestinian territory. This report includes numerous practical proposals to address environmental challenges, drawing upon global best practices as well as an understanding of the situation on the ground.

I would like to thank both the Palestinian and Israeli Governments for their cooperation, flexibility and sustained support to UNEP during the production of this report. I also express my gratitude to international partners and United Nations colleagues who contributed to the process.

In a context of acute regional tension and uncertainty, establishing and maintaining measures to protect the Palestinian environment will require creativity and commitment. We urgently need to find ways to overcome current challenges and begin to reverse trends of environmental degradation and pollution that have now been evident for decades.

I hope that this report contributes to a better understanding of the severity of environmental challenges facing the occupied Palestinian territory, and to a renewed commitment among all stakeholders to put in place solutions – for the sake both of current and future generations.

Inger Andersen
Executive Director,
UN Environment Programme and
Under-Secretary-General of the United Nations

Executive Summary

This report provides an overview of the current state of the environment in the occupied Palestinian territory. Building on earlier work by the United Nations Environment Programme (UNEP), the report includes analysis of the current state of the environment, including biodiversity, water, land and soil degradation, depletion of natural resources, urbanization and waste management. The report describes trends and identifies emerging environmental challenges, including environmental governance challenges. This analysis is intended to provide a basis for evidence-informed policies.

Methodological approach and sources

UNEP uses the drivers-pressures-state-impact-response causal framework approach. This represents a systems analysis view in which the **driving forces of social and economic development exert pressures on the environment,** and change the state of the environment. This change leads to impacts on human well-being and ecosystem health, which in turn triggers human responses to remedy these impacts. These responses influence the state of the environment, either directly or indirectly, through driving forces or pressures. Existing policies should be assessed in terms of how they address the drivers and impacts of environmental challenges.

The evidence in this report was gathered through the following methods:

- Review of data and analysis from available government sources, reports by international organizations and peer-reviewed scientific papers;
- Consultations with Palestinian and Israeli officials and other stakeholders, undertaken during missions in December 2018 and February to March 2019, and via follow-up calls and correspondence; and
- Field visits to over 40 sites by a UNEP delegation to the Gaza Strip, the West Bank, including East Jerusalem, and to Israel, undertaken in February and March 2019, to review and record evidence of noticeable environmental change.

The report was also reviewed by expert practitioners before publication in 2020.

Drivers of environmental change in the occupied Palestinian territory

In analysing drivers of the state of the environment in the occupied Palestinian territory, this report arranges drivers under the following headings: climate change and underlying environmental conditions; socioeconomic drivers; and environmental governance constraints.

Climate change and underlying environmental conditions

The occupied Palestinian territory lies within a generally hot, arid and water-scarce region that has experienced an increase in temperatures over the past fifty years. Climate projections indicate that by mid-century, the temperature will increase by between 1.2°C and 2.6°C. Climate change modifies the water cycle by altering precipitation patterns and seasons: average monthly precipitation may fall by 8–10 mm by the end of the century, and seasonal rainfall patterns may also change, leading to greater aridity. Climate-related hazards, such as heatwaves, droughts, floods, cyclones, and sand and dust storms, are projected to become more frequent and severe.

Socioeconomic drivers

High population growth is often a significant driver of environmental change. The Palestinian population is increasing at a yearly rate of 2.7 per cent. The total population in 2019 was estimated at almost 5 million and is expected to increase to 6.9 million by 2030. Population density is very high in Gaza and some areas of the West Bank, including East Jerusalem. Urbanization has occurred rapidly with inadequate planning. Population growth puts pressure on natural resources and service delivery systems: the amount of solid waste generated each year in Gaza, for example, is projected to increase to over 3,000 tonnes in 2030, from around 1,900 tonnes in 2015. Population growth has also contributed to the increase in land value, leading to the sale of land for urban infrastructure and the expansion of building onto agricultural lands. Settlement expansion in the West Bank and East Jerusalem puts additional pressure on limited natural resources, further contributing to the pollution of air, soil and water.

Environmental governance constraints

The political situation limits the policy space for sound environmental governance, and impedes the use of best practice solutions to address natural resource scarcity and urbanization challenges. Environmental governance constraints drive environmental change in the following ways:

- **Palestinian movement and access to land is restricted to specific areas, leading to high population density, poorly planned urbanization, stresses on infrastructure, and degradation of accessible agricultural and rangeland.** Gaza is enclosed, and in the West Bank urbanization and agriculture have been affected by the constraints Palestinians face in land-use planning. It remains almost impossible for Palestinians to obtain Israeli-issued construction permits in the West Bank, including East Jerusalem.
- **Palestinian policymakers and professionals cannot employ best practice environment management solutions.** In Gaza, management of freshwater, wastewater, and solid waste is impacted by the closure, as well as by the intra-Palestinian divide which impedes environmental governance by the Palestinian Authority. Insufficient waste management capabilities and energy supplies have led to the contamination of soil and groundwater, and the discharge of sewage and wastewater into the Mediterranean Sea. Restrictions on the use of water and land, and on the import of materials and technologies, have affected farming practices: use of irrigation is limited, and farmers use excessive chemical fertilizers and pesticides to increase crop yield.
- **Lack of political progress has led to unclear and overlapping environmental governance arrangements.** The Palestinian Authority faces difficulties in applying Palestinian laws in Areas A and B, and is unable to apply these laws in Area C, or – due to the intra-Palestinian division – in Gaza. Israel applies separate sets of laws to Israeli individuals in the occupied Palestinian territory, and to Israeli settlements, industrial installations and closed military areas. The joint environmental management arrangements that were established as part of the 1995 Interim Agreement are only partly functional. The simultaneous application of different sets of laws, and law enforcement capabilities, in the same territory, leads to data and enforcement gaps.

- Israeli settlements and security measures cause environmental change and degradation. Examples include the uprooting of large numbers of trees (especially olive trees) during the clearance of land for military bases, buffer zones, bypass roads (which are generally inaccessible to Palestinians) and the separation barrier. Despite mitigation efforts by Israel, such infrastructure has impacted delicate ecosystems and biodiversity.

State of the environment: key findings

UNEP found substantial evidence of environmental change and degradation in the occupied Palestinian territory. Surface and groundwater courses and marine ecosystems are being degraded by the discharge of untreated wastewater and by leaching from solid waste and unregulated industries. Rapid population growth, the growth of Palestinian urban areas, the expansion of Israeli settlements, land-use changes and the unsustainable use of natural resources have put severe pressure on ecosystem goods and services.

These factors present mounting challenges to efforts to maintain healthy ecosystems, conserve biodiversity and prepare for the adverse effects of climate change.

1. Gaza is facing a water crisis. The Coastal Aquifer groundwater level has dropped to more than 10 metres below mean sea level. The annual safe yield of the aquifer is 55–60 million cubic meters (mcm); however, approximately 160–200 mcm per year are being extracted. Only 4 per cent of the 180 mcm of water extracted annually by Gaza residents from the aquifer are potable. Access to safe drinking water in Gaza via the public water network fell from 98.3 per cent in 2000 to only 10.5 per cent in 2014. Intensive use of agricultural pesticides, along with the inflow of sewage into the Coastal Aquifer, has resulted in nitrate concentration of 300 mg/L: six times higher than World Health Organization recommendations. Chloride concentrations are also high. These contaminants present particular risks to children and pregnant women. Water-associated diseases account for approximately 26 per cent of childhood diseases in Gaza and are a primary cause of child morbidity.
2. Marine ecosystems, human health and desalination operations are impacted by large-scale discharge of untreated wastewater from Gaza. The amount of untreated or partially treated sewage/wastewater that flows daily from the Gaza Strip into the Mediterranean Sea increased from 90,000 cubic meters (m^3) per day in 2012 to 100,000 m^3 per day in 2016 and 110,000 m^3 per day in 2018.
3. Freshwater courses and groundwater in the West Bank and Gaza are being polluted by waste from Palestinian towns and villages, and from Israeli settlements. Untreated wastewater infiltrates into the groundwater of the Mountain Aquifer, affecting its quality: localized high concentrations of chlorides and nitrates have been identified. The Mountain Aquifer is contaminated by leaching of toxins from unregulated vehicle dismantling and e-waste industries.
4. Demand for water is increasing, primarily due to population growth. The annual domestic supply gap for Gaza and the West Bank is projected to be approximately 79 and 92 mcm respectively by 2030 unless supply and service options are expanded. Half of the Palestinian wells in the West Bank have dried up over the last 20 years. Quantities of water purchased from the Israeli water company, Mekorot, are increasing, and Palestinian Authority debt for such water purchases was estimated at US$335 million in 2017. Non-revenue water – which includes leakages through the system, theft and water supplied to customer who are not billed – is high: approximately 82 mcm of water is lost every year. On average, non-revenue water ranges from 29 per cent at the service providers' level and 15 per cent (10 mcm/year) at the bulk water supply level in the West Bank to 40 per cent in Gaza. Some municipalities lose as much as 53 per cent of their water.
5. Climate change will exacerbate strains on water management structures. The potential for water harvesting and wastewater recycling is underutilized, and institutional arrangements to manage the shared aquifer systems are insufficient. Activities such as deepening and rehabilitation of wells, protection of springs, wastewater recycling and implementation of small-scale desalination units are limited or unsustainable due to lack of support.

6. Solid waste disposal capacities are inadequate. Communities, municipalities and village councils struggle to cover the costs of waste collection, transportation and disposal. In 2019, an estimated 343 tonnes of solid waste per day in the West Bank and 443 tonnes per day in the Gaza Strip were disposed in dumpsites, some of which are located adjacent to agricultural land or urban areas. This waste contaminates the soils in these areas. In Gaza, there are numerous challenges relating to solid waste management, including a lack of investment in environmental management systems and the high quantity of debris that have been generated by military conflicts since 2000.
7. Soil pollution comes from the discharge of raw and untreated wastewater into wadis and agricultural lands, the remains from stone quarries and the stone and marble industry in the form of dust or slurry, and the excessive use of pesticides and chemical fertilizers. Each year, 502.7 tonnes of pesticides are used in the West Bank. Changing crop patterns are also affecting soil biodiversity.
8. Soil, water and air are being polluted by unregulated e-waste, used vehicle processing and other industries. The amount of e-waste coming from Israel and processed in Palestinian villages is estimated to be 57,000 to 64,000 tonnes annually, supporting over 380 businesses, 1,000 jobs, and generating over US$28.5 million per year. The illegal disposal and treatment of e-waste have led to environmental and health hazards affecting people on both sides of the Green Line. When active, burning sites release toxic black smoke that includes benzene, dioxins, mercury and polychlorinated biphenyls. In the West Bank, researchers have identified a strong spatial association between e-waste burn sites and childhood lymphoma. Efforts by Palestinian, Israeli and international entities to address these issues have not achieved a sustained reduction in pollution. In Gaza, unregulated industries are contributing to high incidences of childhood lead poisoning.
9. Eleven Israeli industrial complexes are located in the West Bank, and small scale industrial/commercial activities are located in Israeli settlements. Israel applies environmental regulations in these installations, but inside settlements the Israeli licensing and monitoring mechanisms for industries are less exhaustive in certain aspects than those applied inside Israel. Israeli companies also own and administer at least eight quarries in the West Bank. A further seven quarries are under Palestinian ownership. In several cases, nearby towns and villages are affected by chemical and wastewater runoff, odours and dust from industries and quarries.
10. Land use is changing, and Palestinians are experiencing rapid urbanization. The urban population has almost tripled in the past 25 years. Between 1992 and 2015, the land area under artificial surfaces increased from 1.4 to 4.3 per cent, whereas the area under vegetation cover decreased. This change in land use increases vulnerability to extreme weather events, including flash floods. The proportionate increase in built-up areas in Gaza – from 8.25 per cent in 1982 to 25 per cent in 2010 – has also reduced groundwater recharge. The percentage of land area under cultivation has decreased from 36.54 to 24.4 per cent between 1997 and 2015. Rangelands have been exposed to overgrazing for long periods of time, leading to the disappearance of plant species and to soil erosion.
11. Earthquakes and landslides pose the greatest geophysical risk in the occupied Palestinian territory. A third of surveyed buildings in the West Bank are likely to suffer high damage during an earthquake, and another 40 per cent are likely to suffer moderate damage. Refugee camps are highly vulnerable, yet they are not covered by the Palestinian national disaster risk reduction mechanism.
12. Current environmental governance arrangements have led to data and enforcement gaps. Resolving environmental governance challenges requires enhanced cooperation between relevant Palestinian and Israeli authorities.

Data gaps

There are significant gaps in environmental data relating to the occupied Palestinian territory. Information on fauna and soil biodiversity is limited and there is no systematic recording of soil fertility parameters. Accurate assessment of land use trends is also lacking. Official data on transboundary waste movements of all types, including hazardous, solid waste and e-waste are not available.

There are also significant data gaps relating to water, including on withdrawal from groundwater sources in the West Bank and water quality data. A further scientific assessment would be warranted to quantify the damage caused by over-abstraction and pollution of the Mountain Aquifer and Coastal Aquifer. Water losses in delivery systems, and locations of such losses, should be assessed accurately. Steps then need to be taken to minimize loss. More precise estimates of the reduction in water availability due to the impact of climate change also need to be calculated.

Recommendations

This report reviews environmental challenges, constraints, and opportunities in the primary environmental sub-sectors, including terrestrial and marine ecosystems, biodiversity, water, air quality and climate, the urban environment, land degradation and soil contamination. Recommended actions within these sub-sectors are listed at the end of each chapter. All recommendations should be implemented: failure to address any aspect of environmental management and protection covered in this report would have serious implications for the future.

Environmental policy development and implementation in the occupied Palestinian territory occurs in a context of uncertainty, division and political impasse. In late 2019, the United Nations Secretary-General expressed great concern about the "challenges to the international consensus to achieve an end to the occupation and the realization of a negotiated two-State solution of the Israeli-Palestinian conflict" and reiterated his call for "concrete steps in support of ending the occupation and realizing a lasting peace." In this context, and mindful of constraints to development planning and environmental governance, it is necessary to highlight environmental issues that must be resolved urgently, to prevent irreversible damage to ecosystems and human health. Other issues must be resolved over a longer timeframe – starting now, and aiming for results by the mid-decade, or by 2030.

Priorities for environmental protection and management are described below:

BEFORE 2023:

1. **Tackle severe pollution from waste, especially e-waste and other hazardous waste.** Pollution from the informal e-waste sector and unregulated industries is already affecting human health, particularly the health of children; if uncontrolled, it may have major, long-term health impacts, which cannot be confined to specific geographical areas. Solutions are available and must urgently be implemented, with full cooperation from all stakeholders, in line with target 12.4 of the Sustainable Development Goals.
2. **Scale up efforts to harvest, preserve, treat and reuse water.** Climate change will exacerbate water scarcity, which will in turn impact the Palestinian environment and economy. An urgent, concerted push is required to protect the Coastal Aquifer. Water management faces many challenges: work must accelerate now, across the occupied Palestinian territory, in the following areas:
   a) Enhance rainwater harvesting, where relevant using new technologies, to increase the availability of potable water and water for agriculture;
   b) Reduce losses from the water distribution system;
   c) Significantly reduce pollution of fresh watercourses and the Mediterranean Sea, in line *inter alia* with targets 6.3 and 14.1 of the Sustainable Development Goals;
   d) Increase the reuse of wastewater and educate key stakeholders such as farmers; and
   e) Enhance wastewater treatment in Gaza – without which investment in desalination will not yield full benefits for the people of Gaza.
3. **Invest in natural resource-based livelihoods that promote climate resilience and land restoration.** Initiatives such as the Greening Palestine Programme and use of drought-tolerant fodder crops in rangeland have already contributed to small increases in grassland and tree-covered areas in the West Bank. Broadening such initiatives, and investing in sustainable production, processing and marketing of non-timber forest products such as olives, honey, dates and medicinal plants, would deliver major benefits to people and the environment.

4. **Explore and develop options for boosting the green economy in the occupied Palestinian territory.** From an economic and human security perspective, growth and job creation are of high importance. In seeking to develop a low-carbon, resource-efficient and socially inclusive economy, Palestinians can draw on relatively high levels of tertiary education, and high and growing human development indicators. Initially it will be important to focus on making the traditional sectors more sustainable and cleaner, to allow time for just transition. To facilitate green growth, the Government of Israel needs to lift relevant restrictions.
5. **Address environmental data gaps and shortcomings.** Agreement on baseline indicators for priority sectors (e-waste and wastewater, among others), and a decision to investigate where data systems are reporting widely varying findings, would help ensure that knowledge about the environment could be fed appropriately into environmental decision-making. UNEP could provide technical support to enhance cooperative knowledge management and scientific data exchange around environmental issues.
6. **Ensure that environmental and climate-related priorities are incorporated into strategic plans.** Environmental protection and climate change risk management should be integrated fully into the Palestinian national development plans and strategies. International actors, including donors and United Nations entities, also need to ensure that their planning and investment strategies are informed by environmental issues and especially by climate-related risks.

BEFORE 2025:

7. **Establish functioning shared environmental monitoring, management and governance systems.** It has been evident for well over a decade that the systems for joint environmental management that were established within the 1995 Interim Agreement are insufficient. To protect the environment and natural resources for current and future generations, Palestinians and Israelis need to establish and agree on transparent, evidence-based systems for environmental governance. These systems need to include:
   a) mutually agreed data collection and monitoring provisions;
   b) clarity about which environmental laws apply in the occupied Palestinian territory, and which entities are responsible for enforcing those laws;
   c) processes to ensure coherent urban and land use planning;
   d) effective mechanisms for transparency and accountability; and
   e) processes for engagement and participation by stakeholders regarding environmental governance, including civil society and the private sector.

   To protect the environment, a functioning, shared environmental management and governance system will be necessary – whether or not progress at the broader political level is achieved.
8. **Promote and invest in urban resilience.** This includes climate resilience, which can be achieved by providing access to safe, affordable, accessible and sustainable transport systems for all (target 11.2 of the Sustainable Development Goals); enhancing air quality and municipal and other waste management (target 11.6); and increasing access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities (target 11.7). It is also critical to focus direct spending on sustainable infrastructure (clean and renewable energy, clean water, sanitation, public transport, waste management and communication).
9. **Work with public and private sector investors to promote sustainable economic development.** This includes greening of the agriculture and fishing sector; helping the producers to meet sustainability standards and support for packaging, labelling and marketing; and tackling existing constraints by proactively seeking partnerships from countries and companies interested and able to invest in a green economy.

BEFORE 2030:

10. **Fund and implement climate change adaptation and mitigation measures.** Adaptation and mitigation measures are described in the Nationally Determined Contributions (NDC) and National Adaptation Plans (NAP) developed by the State of Palestine. Some measures require substantial investment – for example, the transport target includes a 25 per cent shift from private cars to public transport by 2030.

Since agriculture is the sector most sensitive to climate variability and change, additional investments are needed in irrigation, improved water efficiency and climate-smart agriculture. Protecting the Gaza coastline from the impacts of sea level rise, and upgrading utility systems to include renewable energy sources, will also require additional planning and resources.

11. **Scale up ecosystem restoration**. Restoration of landscapes and watercourses could deliver major benefits in terms of climate resilience and land productivity. Several policies are proposed, including new technologies in water harvesting, crop rotation, grazing and rotation management, and enhanced use of agroforestry.

Introduction to the report

The present report builds upon earlier work by the United Nations Environment Programme (UNEP), including the 2003 *Desk Study on the Environment in the Occupied Palestinian Territories, the 2005 Environmental Assessment of the Areas Disengaged by Israel in the Gaza Strip, and the 2009 Environmental Assessment of the Gaza Strip following the escalation of hostilities in December 2008–January 2009.* The recommendations in the present report follow those made in previous UNEP analyses. Emerging issues are also covered.

The United Nations Environment Programme does not have a field presence in the occupied Palestinian territory. Evidence included in this report was gathered through the following methods:

- Review of data and analysis from available government sources, reports by international organizations and peer-reviewed scientific papers;
- Extensive consultations with officials and other stakeholders, undertaken during missions in December 2018 and February to March 2019, and via follow-up calls and correspondence; and
- Field visits to approximately 40 sites by a UNEP delegation to the Gaza Strip and the West Bank including East Jerusalem, undertaken during February and March 2019, to review and record evidence of noticeable environmental change.

The report was also reviewed by expert practitioners before publication in 2020.

The report uses the **driving forces-pressures-state-impacts-response** approach to measure and assess environmental conditions and trends. This framework helps to order the data and information in such a way as to tell the story of environmental change in an integrated fashion, linking causes and effects. **Drivers** describe the socioeconomic driving forces, such as population growth, conflict, poverty, and consumption that contribute to the direct **pressures** that impinge on the environment, including pollution and resource extraction.
The **state** of the environment refers to data and descriptions of trends in environmental conditions over time and space. These three aspects of the framework answer the question “What is happening to the environment?”

The **driving forces-pressures-state-impacts-response** approach allows for analysis of the **impacts** of environmental problems on ecosystem goods and services, society, the economy, and human health and well-being, answering "What are the consequences for the environment and people?" Finally, **responses** refer to how societal actors are addressing environmental and climate issues and with what results, responding to the question "What is being done and how effective is it?" The driving forces-pressures-state-impacts-response is informed by indicators of environmental change that use a variety of visual means including graphs, pie charts, tables, maps, and remote sensing from satellites and aircraft to graphically display the data.

Time series satellite imagery provides a way to monitor the environment's resource base and visually document the extent to which humans and natural processes have had an impact on the environment.

Anticipated results

In the following chapters, readers will find an analysis of the state of the environment which aims to provide a basis for evidence-informed policies and to highlight environmental problems affecting the occupied Palestinian territory. The report analyses key issues including climate change, biodiversity, water, land degradation, depletion of natural resources, urbanization and waste management. It also analyses trends over the recent years and identifies the environmental challenges anticipated in the future.

This analysis and benchmarking of environmental issues will assist Palestinian and Israeli Governments, United Nations agencies, non-governmental organizations, civil society, media and other stakeholders to address and monitor progress towards the achievement of environmental objectives, as well as towards international targets contained within multilateral environmental agreements and Sustainable Development Goals.

The report will help stakeholders make informed decisions about the Palestinian environment and maintain a sustainable environment in the most effective way possible. It will illustrate the interrelationship between people, resources, environment and development, and demonstrate the importance of including the environment as an integral part of socioeconomic planning and policy processes. It will also seek to identify potential solutions and ways to implement them, where possible through existing mechanisms, and to understand the relationship between the environment and people.

Chapter 1: Context

1.1 Geographical scope and context of the report

This report examines the state of the environment in the occupied Palestinian territory. The geographical scope of this area is described in the map below; it includes the Gaza Strip and the West Bank, including East Jerusalem.

The state of the environment in a given area is influenced by a number of factors. Geological, ecological and climatic features provide the foundational environmental characteristics. Environmental change occurs when natural forces, such as tectonic activity and meteorological events, alter or affect those conditions. Environmental change is also caused by human factors, including anthropological climate change and local or regional human activity.

The occupied Palestinian territory lies within a generally hot, arid and water-scarce region that has experienced an increase in temperatures over the past 50 years (UNESCWA et al., 2017). Extreme temperatures and precipitation events have led to a variety of weather- and climate-related hazards in this region, such as heatwaves, droughts, floods, and sand- and dust storms. Such events have also become more frequent and more severe in the region (UNESCWA et al., 2017). These changes are attributable to anthropogenic climate change.

Figure 1
Map of the occupied Palestinian territory (Modified from OCHA 2019)

Looking ahead, projections indicate that the temperature will increase by between 1.2°C–2.6°C at mid-century (representative concentration pathway – RCP 4.5, 8.5) and by up to 4.8°C by end-century. Average monthly precipitation may fall by 8–10 mm by the end of the century (UNESCWA et al., 2017). Delicate marine and terrestrial ecosystems in both the West Bank and Gaza Strip have already been adversely affected by climate change and variability.

The environment of the occupied Palestinian territory is also affected by other anthropogenic drivers, including population pressure and economic development. Urbanization and settlement growth, unplanned distribution of industries, overgrazing, pollution and contaminants all contribute to environmental degradation and threaten biodiversity. Environmental degradation and climate change, in turn, carry society-wide risks, which are generally more profound for the socially vulnerable, particularly women and children

(UNEP, 2019). Environmental management in the occupied Palestinian territory is complicated by the political situation and governance context.

1.2 Environmental governance context

Environmental governance should ensure that information regarding changes to the environment is translated into prompt decision-making processes, and policies to protect the environment and essential ecosystems. Environmental governance mechanisms are important for enhancing environmental cooperation at the global and regional levels, for developing and applying national and international environmental law, and for encouraging links between civil society and governments in the development and implementation of environmental policies.

Environmental governance in the occupied Palestinian territory is complicated by three factors. First, different sets of laws, and law enforcement capabilities, are being applied by different Israeli and Palestinian institutions – with limited cooperation between these institutions. Second, the overall capacity of the Palestinian Authority to manage the environment has been affected by restrictions on Palestinian movement and access, and by political instability, repeated fiscal crises, and persistent internal governance challenges. The third challenge to environmental management and governance is posed by the intra-Palestinian divide, which has a major detrimental impact on the Palestinian Authority's ability to function in Gaza. These three governance challenges are summarized briefly below and analysed in more depth in Chapter 12.

First, while Israel, as occupying power, retains overall responsibility for administration of the territory as spelled out in the 1907 Hague Regulations (Articles 42-56) and the Fourth Geneva Convention (GC IV, art. 27–34 and 47–78), individuals living in the occupied Palestinian territory are currently subject to different sets of environmental laws and regulations, which are applied by Palestinian and Israeli authorities.

This situation has arisen in part because of the persistence of "interim" governance arrangements agreed between Israel and the Palestine Liberation Organization in the 1990s, which have now been in place for well over two decades. In the 1995 Interim Agreement on the West Bank and the Gaza Strip, Israel and the Palestine Liberation Organization agreed inter alia to divide the West Bank into three administrative divisions – Areas A, B and C. According to this Interim Agreement, a Palestinian Council would assume jurisdiction over "populated areas" (Areas A and B) during the first phase of Israeli redeployment from the territory. Area C – defined as "areas of the West Bank outside Areas A and B, which, except for the issues that will be negotiated in the permanent status negotiations" – would be "gradually transferred to Palestinian jurisdiction" (IMoFA, 1995). Arrangements for environmental governance were included in the Interim Agreement.

Although Israel and the Palestine Liberation Organization envisioned a transfer of jurisdiction within five years of the Interim Agreement, this transition has not been implemented. As a consequence, Palestinian governance – including the application of environmental laws and protections – still extends only to Areas A and B. In Area C, Palestinian citizens are subject to laws applied by the Israeli Civil Administration, including Ottoman law, British law, or the Jordanian law of 1967 as amended by Israeli military legislation.

Settlement construction has continued during this period, and there are now over 600,000 settlers living in the West Bank, including East Jerusalem. The official municipal boundaries of Israeli settlements, which cover more than 10 per cent of the West Bank, are declared "closed military areas" and are off-limits to Palestinians (OCHA, 2017).

Israeli citizens located in the occupied Palestinian territory are subject to personal (extraterritorial) application of some aspects of Israeli law. In addition, Israel makes use of military orders to apply provisions of specific laws relevant to the environment within settlements. (Details are provided in Chapter 12 of this report.)

Refugee camps are administered by yet another set of arrangements. The United Nations Relief and Works Agency for Palestine Refugees states that the camps suffer from a lack of "regulatory frameworks and governance", which leads to a situation in which "planning and construction in camps can be described as haphazard, characterized by overcrowding and inadequate living space". Camp residents are also vulnerable due to the "lack of a comprehensive emergency

preparedness and response capacity" (UNRWA). Rules that apply to other densely-populated areas – for example, Palestinian Authority zoning and planning regulations – are not applied in the camps.

Environmental management is complicated by these overlapping sets of environmental governance arrangements. Application of environmental laws and protections is further complicated by the fact that administrative divisions in the West Bank are not visible on the ground, and the movement of law enforcement officials is restricted. Palestinian law enforcement officials are not able to access Areas B or C without permission, which impedes their independent pursuit of individuals suspected of unauthorized dumping or other environmental crimes, beyond Area A. Coordination between Israeli and Palestinian institutions relating to environmental management and governance is currently limited.

The overall capacity of the Palestinian Authority to manage the environment has been affected by restrictions on Palestinian movement and access, and by political instability, repeated fiscal crises and persistent internal governance challenges.

During the past two decades, Palestinians and the international community have invested billions of dollars in developing Palestinian self-governing institutions, including the Palestinian Environment Quality Authority. Although the Palestinian Authority has continued to strengthen its institutions, "delivering public services and promoting reforms that many existing states struggle with" (World Bank, 2011), significant policy constraints remain, restricting the Palestinian Authority's ability to deliver.

The restrictions imposed by Israel on the movement of Palestinian people and goods have been described by the United Nations and the World Bank in several other reports – see, for example (OCHA, 2017). Israel restricts Palestinian movement within the occupied Palestinian territory, including between the Gaza Strip and West Bank, through a combination of physical obstacles, bureaucratic constraints and the designation of areas as restricted or closed.

Palestinian access to areas within the West Bank, and to the natural resources in these areas, is constrained: in 2016, the Quartet reported that some "70 per cent of Area C has been unilaterally taken for exclusive Israeli use, mostly through inclusion in the boundaries of local and regional settlement councils or designations of "state land". Nearly all of the remaining 30 per cent of Area C, much of which is private Palestinian property, is effectively off-limits for Palestinian development because it requires permits from the Israeli military authorities that are almost never granted" (United Nations, 2016). In late 2019, the United Nations reported that Israeli authorities had continued to demolish Palestinian-owned structures, citing the absence of Israeli-issued building permits, which at the time of reporting remained "almost impossible for Palestinians to obtain" (United Nations, 2019). Settlement activities have also eliminated, or put at risk, Palestinian access to many West Bank water springs. A survey carried out by the United Nations Office for the Coordination of Humanitarian Affairs in 2011 identified a total of 56 such springs, the large majority of which are located in Area C (93 per cent), on land parcels recorded by the Israeli Civil Administration as privately owned by Palestinians – at least 84 per cent. (OCHA, 2012). Israel's planning regime in Area C and East Jerusalem, the increased fragmentation of territory by settlements, roads and the separation barrier, and the lack of freedom of movement and jurisdiction have limited the ability of Palestinian institutions to govern, deliver services and access natural resources (United Nations Country Team, 2016).

The development trajectory of Palestinian institutions and their capacity to plan and implement projects has also been impeded by periodic political crises and severe budget cuts. In April 2019, the Palestinian Authority faced an "unprecedented fiscal challenge" and was seeking to cope with the loss of 65 per cent of its revenues, equivalent to some 15 per cent of gross domestic product, due to a dispute with Israel about the transfer of clearance revenues that Israel collects on the Palestinian Authority's behalf (UNSCO, 2019).

Within this overall context, the Palestinian Environment Quality Authority is a small entity whose mandate exceeds its capacity. As with other Palestinian institutions, the Environment Quality Authority is often pushed to attend to immediate, visible problems rather than on strategic priorities, including addressing the most harmful environmental hazards (Karlstedt, Ockerman, Danani, & Daifi, 2014).

The third challenge to environmental management and governance is posed by the **situation in Gaza.** The Hamas takeover of Gaza in June 2007, the ensuing military build-up, and the administrative division that followed between the Palestinian Authority and Hamas has had a significant impact on administration and public services in Gaza. In 2007, the Palestinian Authority ordered some 70,000 of its employees in Gaza not to report to work, and Hamas recruited thousands of its own employees and security personnel. Employees of the Environment Quality Authority were affected by this change. Despite repeated efforts to promote unity, Gaza and the West Bank remain divided, administered separately and on progressively divergent policy directions. The division has also resulted in the establishment of two different law-making processes and the enactment of diverging laws in Gaza and the West Bank (UNCT, 2017).

Gaza has continued a trajectory of de-development since Hamas took *de facto* control in 2007. The socioeconomic situation has been severely impacted by the closure of Gaza by Israel, and Hamas militant activities, the intra-Palestinian divide and, over the past few years, decreasing amounts of international assistance. Rounds of hostilities between Israel and Hamas, including the 2014 conflict, caused severe damage to infrastructure in Gaza, including the power plant,

Box 1: Palestinian vision, goals and environmental strategy

The Palestinian Authority's vision for development is set out in the State of Palestine National Policy Agenda (2017-2022). This is the fourth national development plan since 2008. Its stated aims are to bring peace, stability and prosperity by investing in the social environment (SP, 2016). The National Policy Agenda has three pillars: Path to independence, Government reform and Sustainable development.

Environmental priorities are incorporated under the pillar of Sustainable development. Within this pillar, "Creating resilient communities" involves:

- Ensuring community and national security, public safety and rule of law;
- Meeting the basic needs of communities;
- Ensuring a sustainable environment and adapting to climate change;
- Revitalizing agriculture and strengthening rural communities; and
- Preserving national heritage and culture.

Palestinian environmental strategy and goals are set by the Palestinian Environment Quality Authority within the framework of the Palestinian Environment Law No. 7/1999 (PLC, 1999) and Article 33 of the Palestinian Basic Law (COM, 1997). The Environment Quality Authority has regulatory and policy authority for all environmental issues. Its primary concern is the conservation and sound use of the natural environment while ensuring human well-being.

Box 2: Palestinian institutional and legal constraints

The following are institutional and legal deficiencies that affect all aspects of governance, including environmental protection and especially land-use planning and management (World Bank, 2008).

- Lack of and weak enforcement of legislation;
- Weak institutional capacities and capabilities of the public and private sector, non-governmental organizations and civil society organizations, and weak coordination mechanisms among them;
- Weak services and service delivery systems to stakeholders, including herders and farmers;
- Weak participation of different stakeholders in decision-making processes;
- Lack of information and reliable data;
- Lack of awareness among people, media, legislators and decision makers;
- Low interest and budget allocation from the Palestinian government and international communities to implement interventions aiming to combat desertification;
- Lack of proper national policies, strategies and commitments to combat desertification and lack of application of the proper incentives, and policy tools and instruments;
- Weak regional cooperation; and
- Ambiguity and overlap of responsibilities.

water supply and sewage system, and also led to large scale destruction of farmlands and orchards (UNCT, 2017).

Disputes between the Palestinian government and the *de facto* authorities' over payments for, and governance of, the electricity sector in Gaza also impeded progress towards finding more sustainable solutions and contributed to a reduction in electricity supply. Israel has simultaneously restricted imports of many goods that are critical for efficient and sustainable energy and water infrastructure, but which are deemed by Israel to have dual civilian and military use. This has often delayed or impeded implementation of critical projects. However, the Gaza Reconstruction Mechanism, agreed between the Government of Israel and the Palestinian Authority, has facilitated the import of a significant number of restricted goods over the past five years, enabling the completion of nearly 150 water and energy projects.

Beyond legal and governance frameworks, public attitudes play an important role in determining the state of the environment. Some analysts have noted a limited sense of public responsibility for the upkeep of shared public spaces (Isaac, 2014). This may be due to the lack of clear structures or systems in which the public can participate effectively in the protection of these spaces (Ma'an Development Center, 2014). Sound environmental management presupposes an attitude of respect for, and custodianship of, the natural world. This attitude may be harder to instil when land ownership, governance, and the political future remain highly uncertain.

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Chapter 2: Geography

Environmental change is influenced by geographic conditions and climate. The following chapter describes the geography of the occupied Palestinian territory, including landforms and topography, climate, soil, biographical and phytogeographical regions, and agroecological zones.

2.1 Landforms and topography

The occupied Palestinian territory is characterized by a great variation in topography and climate. This variation is directly reflected by the distribution and diversification of agricultural and biogeographic patterns. The climatic and geographic factors allow for successful irrigated agriculture in the Jordan Rift Valley (the lowest area in the world) and rain-fed farming in the mountains (ARIJ, 2015). The landscape and altitude show great variation. This varied topography directly influences the climate, ecosystems and biodiversity of the area.
Based on the geomorphology, the West Bank is divided into four areas – the central highlands (where most of the population lives), the semi-coastal region, the eastern slopes region, and the Jordan Valley. The mountains of the West Bank serve are the main catchment area feeding the groundwater aquifers (ARIJ, 2015). Most of the hills in the West Bank are formed from limestone, while fertile soils are found in the valleys; however, the soil cover is thin and rainfall erratic.

Figure 2
Topography of the occupied Palestinian territory

The Gaza strip is a generally flat area with widespread sand dunes, gradually slopping westwards. Active dunes can be found near the coast, especially in the southern part between Deir el Balah and Rafah. The sand is permeable with good porosity. Sand quarries are common and unregulated, and have transformed the natural habitats for biodiversity (Thawaba, et al., 2017). To the north are four ridges (Coastal ridge, Gaza, El-Muntar, and the Beit Hanoun ridge) ranging from 20 to 90 metres above sea level. Areas with large accumulations of loess can be found 15 km southwest of Gaza and east of Khan Yunis (ARIJ, 2015).

2.2 The climate

The occupied Palestinian territory is located within the Mediterranean climatic zone and is typified by cool, wet winters and hot, dry summers (Figure 3A-C). The southern part of the Jordan Valley exhibits a transitional climate zone between dry steppe and the extreme desert conditions of the Dead Sea region. Box 3 describes the climate of the West Bank in more detail. During spring and early summer, temperatures are high, humidity low and desert sand storms (called khamaseen) are common.

Temperature: The average temperatures range between 25°C in summer to 13°C in winter. The highest temperatures are found in Jericho and the Jordan Valley, increasing from north to south and are inversely related to altitude, with the highest temperatures being found in the area of the Dead Sea. The Gaza Strip is located in a transitional zone between the arid desert climate of the Sinai Peninsula and the temperate and semi-humid Mediterranean climate along the coast (ARIJ, 2015).

Precipitation: The rainy season occurs during the winter starting mid-October until May. Snow and hail have been known to occur in highland areas of the West Bank. Average annual rainfall in the West Bank and the Gaza Strip is recorded at 535 mm and 359 mm respectively (ARIJ, 2015).

Sunshine duration: Solar radiation is highest in the summer months of June and July and shortest during the winter months of December to February. Cloud cover during the winter months results in a reduction in radiation (ARIJ, 2015).

Relative humidity: Humidity varies from 50 to 70 per cent. The Gaza Strip has the highest annual mean relative humidity at 69 per cent and Jericho (Jordan Valley) has the lowest at 52 per cent, decreasing from winter to summer (ARIJ, 2015).

Box 3: Description of the climate of the West Bank (Muhsen, 2017)

- Semi-coastal region: Mediterranean climate.
- Central Mountain region: Mediterranean climate on the western slope facing the Mediterranean Sea. Arid on the eastern slope facing the Jordan Valley.
- Eastern slopes: semi-arid climate (semi-humid in some areas). Elevation range from 200 to 1,000 m.
- Jordan Valley: borders Jordan. Arid and semi-arid, high temperatures and a low average annual rainfall of 100 to 200 mm

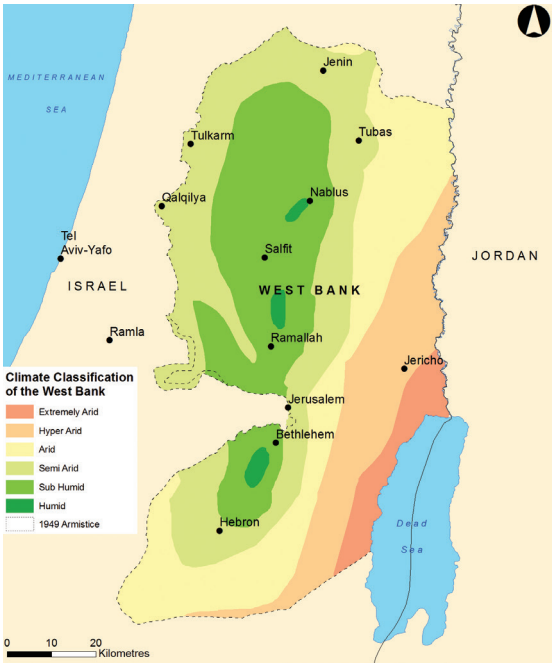


Figure 3A
Climate classification (SP, 2015)

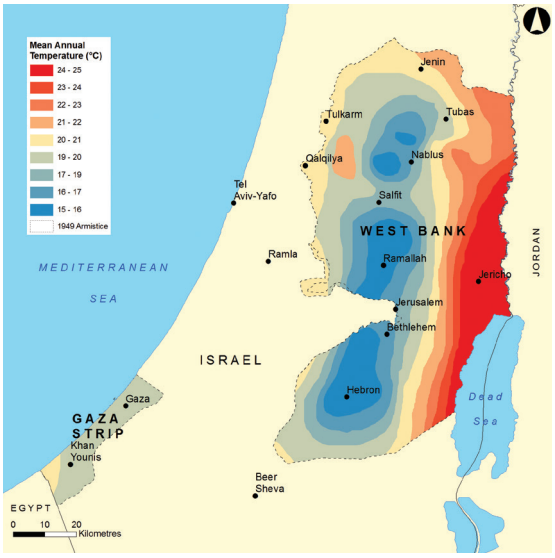


Figure 3B
Mean annual temperature (SP, 2015)

Figure 3C
Average annual rainfall (SP, 2015)

Evaporation: Evaporation is particularly high in the summer due to the rise in temperature, high incident solar radiation, and low humidity. Evaporation rates are highest in the Jordan Valley in the summer months with total annual evaporation reaching about 2,100 mm. Evaporation from the Dead Sea is particularly high due to intense solar radiation and low relative humidity. Towards the coastal plain, the rate of evaporation decreases due to continual exposure to the humid sea breeze. Evaporation rates are relatively low during the winter months when the solar radiation is lowest, with the lowest evaporation rates occurring in December. Evaporation in the Gaza Strip is the lowest anywhere in the occupied Palestinian territory (1,580 mm per year), due to high relative humidity, lack of surface water, less intense solar radiation and fewer hours of sunlight (ARIJ, 2015).

2.3 Soil

Soils are formed due to several conditions including climate, physical weathering from wind, water, and other topographic materials, geology and vegetation. The major soil associations are terra rossa and brown rendzinas, dominating the central highlands of the West Bank. Brown rendzinas and pale rendzinas are found to the north and south of the mountain ridge, in Tubas, Qalqiliya, and Hebron Governorates, and also in regions of the eastern slopes. In the Gaza Strip, the most common soil type is grumosols, which dominates the semi-arid loess plain area. Grumosols are also found in the far north and far

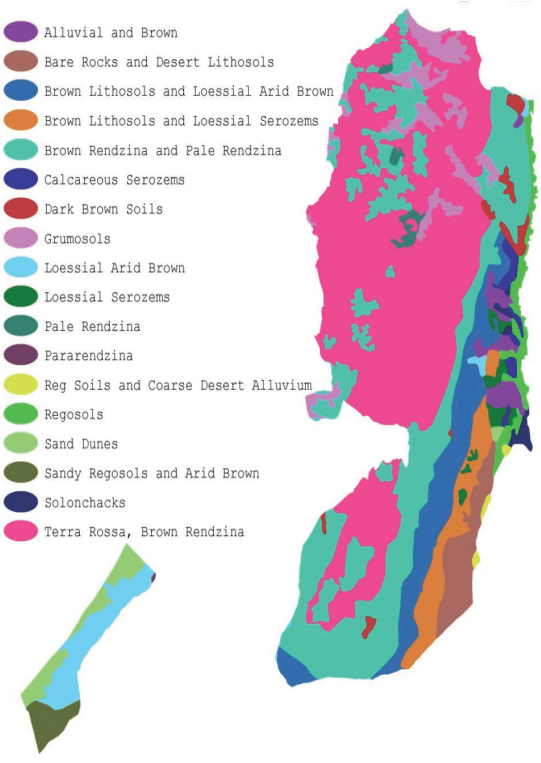
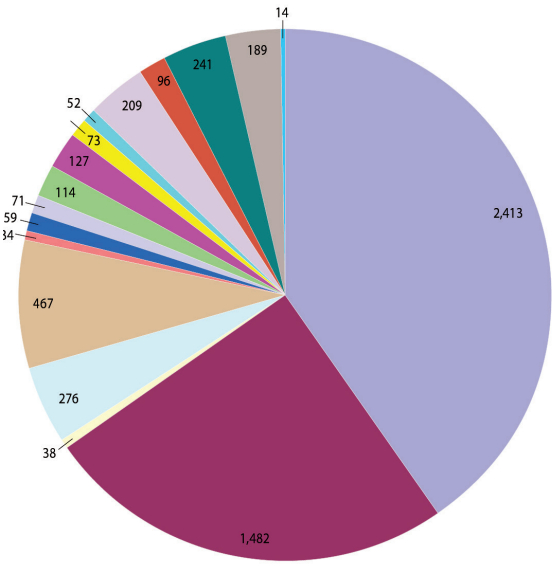


Figure 4
Soil association map (Ghanma, 2012)



- Regosols
- Dark Brown Soils
- Calcareous Serozems
- Loessial Arid Brown Soil
- Alluvial Arid Brown Soils
- Brown Lithosols and Loessial Serozems
- Bare Rocks and Desert Lithosols
- Reg Soils and Coarse Desert Alluvium
- Terra rossa
- Brown Rendzinas and Pale Renzinas
- Pale Rendzinas
- Grumusols
- Brown Lithosols and Loessial Arid Brown Soils
- Solonchaks
- Loessial Serozems
- Sandy Regosols and Arid Brown
- Sand Dunes

Figure 5
Distribution of soil associations (Ghanma, 2012)

Figure 6
Soil types in the Gaza Strip (Shomar, Fakher, & Yahya, 2010)

west of the West Bank, coinciding with low-lying areas that enjoy a more temperate climate than other parts of the highlands. The soil resource of an area is one of the most important elements of its natural resources' base (ARIJ, 2015). Figure 4 shows the dominant soil types of the West Bank and Gaza Strip.
Figure 5 shows the relative amount of each soil association in the occupied Palestinian territory.

The Gaza Strip has several major soils types including arenosolic, calcaric, rhegosolic, and calcaric fluvisolic soils (Figure 6). Arenosolic (sandy) soils of dune accumulations are regosols without a marked profile. The soils are moderately calcareous (5–8 per cent of $CaCO_3$), with low organic matter, and are physically suitable for intensive horticulture. Calcaric arenosols (loessy sandy soils) can be found some 5 km inland in the central and southern part of the Gaza Strip, in a zone along Khan Younis toward Rafah, parallel to the coast. This belt forms a transitional zone between the arenosolic soils and the calcaric (loess) soils. Typical calcaric soils are found in the area between the city of Gaza and the Wadi Gaza and contain 8–12 per cent of $CaCO_3$. Arenosolic calcaric (sandy loess) soils are transitional soils, characterized by a lighter texture (Shomar, Fakher, & Yahya, 2010).

Table 1: Dominant soil associations in the Palestinian Governorates (Salem, Hilal, & Ghattas, 2007).

West Bank										
	Jenin	Tubas	Tulkarm	Qalqiliya	Salifit	Nablus	Ramallah	Jericho	Bethlehem	Hebron
Terra rossa and brown rendzinas	X		X		X	X	X			
Brown rendzinas and pale rendzinas		X		X						X
Regosols								X		
Bare rocks and desert lithosols									X	

Gaza Strip					
	Rafah	khan Yunis	Deir Al Balah	Gaza	Jabaliya
Sandy regosols	X				
Grumusols		X	X	X	
Dark brown soils					X

Dominant soil associations are summarized in Table 1.

2.4 Biographical and phytogeographical regions

Biographical regions
Following are descriptions of the major biographical regions (Figure 7A-C) (EQA, 2012):
The central highlands: This is the mountainous portion of the West Bank including East Jerusalem.
The semi-coastal region: This area, located in the Jenin, Tulkarm and Qalqilya districts, is an extension of land inside the Green Line (the 1967 borders). It is 120 square kilometres in area and has an average annual rainfall of 600 millimetres.
The eastern slopes: This area runs from Jenin in the north to Hebron in the south. It is often referred to as the "Jerusalem wilderness".
The Jordan Rift Valley: This is a unique area that lies east of the West Bank highlands, between the eastern slopes and the mountains of Moab in Jordan. A semi-arid region with mild to warm winters and hot, dry summers; it is a continuation of the African Rift Valley.
The Gaza Strip: This is the coastal zone along the eastern Mediterranean. The area has one of the highest population densities in the world.

Phytogeographical regions
Based on the geographic distribution of plant species, these regions are divided as follow:
The Mediterranean region: The Mediterranean region extends along the coastal plain to the north

of Gaza Strip, the central highlands, and the northern part of the Jordan Rift Valley and the western slopes of the Nablus, Jerusalem and Hebron Mountains, ending 65 kilometres south of Jerusalem.

The Irano-Turanian region (oriental steppe)

This region consists of a narrow longitudinal belt to the east of the Mediterranean area. It covers the southern parts of the West Bank (the Jerusalem and Hebron wilderness, central Jordan Rift Valley and adjacent steppes and rocky areas facing the southern part of the Jordan Rift Valley).

The Saharo-Arabian region

The Saharo-Arabian region is characterized by large expanses of gravels, curcar, salines, and sand dunes along with the complete lack of cultivation, except for a considerable number of seasonal plant communities in and around springs and some trees near frequent water resources.

The Sudanese penetration region

This region is a transitional zone between the Sudanese area and the Arabian Desert.

2.5 Agroecological zones

The occupied Palestinian territory has five distinct agroecological zones (Figure 7A) which are summarized in table 2 (EQA, 2012):

The occupied Palestinian territory has an array of soil types, land cover, biogeographical and phytogeographical regions, and agroclimatic zones.

A systematic understanding of the interactions of the biophysical system with the socioeconomic system is important to determine the value of the variety of ecosystem goods and services for human well-being, and also their consequences and actions for the sustainable use of these ecosystems.

Figure 7A
Biogeographical zones of Palestine
Modified from (IUCN, 2015)

Figure 7B
Phytogeographical regions of Palestine
Modified from (IUCN, 2015)

Figure 7C
Biotope map of Palestine
Modified from (IUCN, 2015)

Table 2: Agro-ecological zones

Zones	Area (km2)	Rainfall (mm/yr)	Agricultural activities
The Jordan Valley	400 – to the east of West Bank	100–200. Semi-tropical.	Intensive production (citrus and banana, date palm, grapes, herbs and vegetables).
The eastern slopes	1,500	150–300. Semi-arid or desert.	Small parts for agriculture (irrigated) with spring water; main activity is grazing livestock.
The central highlands	3,155 – the largest part of the West Bank	300–600. Mountains and hills.	Rainfed crops (olive, stone fruits, field crops, vegetables, and fodder).
The semi-coastal zone	600	400–700. The soil is medium-textured of alluvial origin.	Olives, stone fruits, field crops and vegetables.
The coastal zone (Gaza Strip)	365 – entirely within the Gaza Strip.	200–400. Sand dunes, intensive agriculture.	Strawberries, cut flowers, citrus, vegetables, almonds, dates and guava.

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Chapter 3: Demography

3. 1 Palestinian population

The number of Palestinians living in the occupied Palestinian territory in 2019 is estimated to be almost 5 million (PCBS). This population is expected to grow to 6.9 million by 2030 and to 9.5 million in 2050 (UNFPA, 2016). Although fertility rates are falling (UNFPA, 2016); (PCBS, 2018a), rapid demographic growth is projected because of a "youth bulge": in 2014, 30 per cent of the population was between 15 and 29 years old. Population momentum is "built-in" by this very young age structure, with a large cohort of women at reproductive age.

According to the Palestinian Central Bureau of Statistics, approximately 40 per cent of the Palestinian population lives in the Gaza Strip, with the remainder living in the West Bank, including East Jerusalem (PCBS, 2018b). The population of Gaza is growing at a faster rate than that of the West Bank: by 2030, it is expected to exceed 3 million. The population density in the Gaza Strip, at 5,203 people/km2, is 10 times higher than in the West Bank (PCBS, 2018b).

When inadequately managed, and especially when combined with poverty, increased population density and urban sprawl have negative environmental impacts. Poorly delivered services such as public transport, water supply, waste collection and energy degrade the environment. Unplanned urban growth also leads to land degradation, loss of biodiversity, high greenhouse gas emissions and air pollution, among other environmental problems that in turn affect human health and well-being (UNEP, 2019).

These negative environmental impacts are already obvious in the occupied Palestinian territory. The environmental consequences of high population density, combined with weak environmental management, are most evident in Gaza: the Coastal Aquifer, on which Gazans rely for water, is heavily over-extracted and may already be irreversibly damaged (Weibel, 2017); and over 100,000 cubic metres of sewage are being pumped into the sea every day (for updates, see OCHA Gaza Strip Early Warning Indicators (OCHA, 2019)). In the Palestinian communities of East Jerusalem, the urban growth rate is 3.3 per cent, population density is an average of 13,500 capita per km2 and the poverty rate is 75.4 per cent. These conditions, combined with environmental governance

Figure 8
Population by governorate (PCBS, 2018b)

challenges, have contributed to increased water scarcity, water pollution due to contamination by agrochemical runoff, sewage and solid waste leaching. In addition, the water in Gaza is affected by increased amounts of salts and nitrates (MoLG, 2016).

3.2 Israeli settler population

There has been a substantial increase in the Israeli settler population of the West Bank and East Jerusalem over past decades. In 2016, the Quartet reported that “Since the beginning of the Oslo process in 1993, the population of settlements has more than doubled, with a threefold increase in Area C alone.” (UN, 2016). During the years since this Quartet report was published, there has been a further increase in the settler population: there are now over 600,000 settlers in the West Bank including East Jerusalem (OCHA, 2017).

The growth of the settler population has an impact on the environment of the occupied Palestinian territory. Settlement expansion and the developments of factories inside settlements has led to an increase in the amount of groundwater being extracted, to the pumping by some settlements of untreated wastewater into wadis and agricultural lands, to industrial pollution, and to land and soil degradation. These impacts are described in more detail in Chapters 7, 9 and 10 of this report.

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Chapter 4: Socioeconomic aspects

4.1 Structure of the economy

The World Bank described Palestinian economic prospects in 2019 as “grim” (World Bank, 2019). Lack of progress towards peace and reconciliation, combined with longstanding restrictions on the movement of people and goods, have led to economic stagnation. Recently, economic growth in the occupied Palestinian territory has been affected by a steep reduction in official transfers (clearance revenues) and a decline in investment. In 2018, real growth was a mere 0.9 per cent, with a 7 per cent contraction in Gaza while growth in the West Bank was less than its average in recent years at 3 per cent. Looking forward, the World Bank projects that economic growth will average around 1 per cent in the coming years. In light of the population trends described in Chapter 3 above, this implies a continuous decline in real per capita income and a further rise in unemployment and poverty (World Bank, 2019).

Constraints imposed by the Government of Israel in the West Bank, along with the decade-long closure imposed on Gaza, have contributed to a hollowing out of productive sectors, and have left the economy reliant on consumption-driven growth (World Bank, 2019). For a small open economy, prosperity “requires a strong tradable sector with the ability to compete in the global marketplace. The faltering nature of the peace process and the persistence of restrictions on trade, movement, and access have had a dampening effect on private investment and private sector activity. The manufacturing sector, usually a key driver of export-led growth, has stagnated since 1994, its share in gross domestic product falling from 19 per cent to 10 per cent by 2011.” (World Bank, 2014).

Restrictions imposed by Israel in Area C have been particularly detrimental to the Palestinian economy: the economic impact of these restrictions has been analysed extensively by the World Bank (main findings relevant to the environment and natural resources are summarized in box 4).

Box 4: Area C and the future of the Palestinian economy: summary of findings relevant to the environment and natural resources (World Bank, 2014)

Restrictions affecting Palestinian access to land and water

Area C "includes almost all the land of the West Bank suitable for agricultural production… Palestinian access to much of this land, though, is either prohibited or severely restricted". Furthermore , "While most of the West Bank's aquifer and spring water is located in Area C, Palestinians have not been able to draw their agreed allocation of 138.5 mcm per annum." The three underground aquifers in the West Bank "are either located entirely in Area C (the eastern aquifer) or shared with Israel (the north-eastern and western aquifers)… Digging wells or building water conveyance and wastewater treatment and reuse infrastructures requires [Israeli] approval". Approximately "half of the Palestinian wells have dried up over the last 20 years – with the result that total Palestinian water production in the West Bank has dropped by 20 mcm per year since 1994". In addition to impacts on agriculture, the restrictions on Palestinian access to water in and across Area C "also impact the main economic sectors" including industrial and construction sectors.

Settlement agriculture

"The area cultivated by the settlements in the West Bank has expanded rapidly, growing by 35 per cent since 1997 and reaching around 93,000 dunums in 2012. The cropping pattern of settler agriculture suggests good access to water and consequently higher productivity… better access to water would enable a similar shift in the cropping pattern and increased productivity of agriculture in the Palestinian economy." The World Bank's conservative estimate "suggests that the potential agricultural value of the settlements' land used for agriculture is at least US$251 million, equivalent to US$196 million in value-added".

According to information supplied to UNEP by the Israeli authorities, half of the irrigation water used in settlements is treated wastewater, and settlements also use saline water for irrigation (GoI, 2019).

Low Palestinian agricultural labour productivity

Israeli restrictions impede Palestinian access to land and water, and constrain "the development of the infrastructure needed for modern market-oriented agriculture". This has contributed to "abnormal trends" relating to Palestinian agricultural labour productivity – notably a decline in the ratio of labour productivity in agriculture relative to the economy as a whole of more than 50 per cent between 1995 and 2011. This is "explained by the various restrictions on Palestinian access to and investment in the land and water resources of the West Bank… The fact that workers have not abandoned agriculture and that the sector has not witnessed any appreciable intensification speaks to the difficulties of developing alternative economic activities as well as to the limitations placed on agriculture itself".

Restrictions affecting tourism, exploitation of Dead Sea minerals, and quarrying

"Area C has major global tourism potential, but for Palestinians, this remains largely unexploited due to a large degree to current restrictions on access and investment, in particular around the Dead Sea." The Palestinian economy is unable to benefit from the exploitation of Dead Sea minerals, whereas "Israeli companies generate around US$3 billion annually from the sale of Dead Sea minerals (primarily potash and bromine) and from other products, which are derived from the Dead Sea". Palestinian quarrying is also heavily restricted, while Israeli companies operating in Area C produce about 12 million tonnes of construction material per year from quarries in the West Bank, mainly gravel.

The current structure of the economy, which is dominated by the service sector, is shown in Figure 9. The value added by the secondary sector (industry and manufacturing) in 2016 was 20 and 12 per cent respectively; agriculture, forestry and fishing now account for 3 per cent, compared with 32 per cent in 1975 (UNCTAD, 2016); (World Bank, 2017). While the contribution of agriculture, including fishing, to the gross domestic product has declined, the sector composes almost a third of the gross domestic product generated in tradable activities and agriculture and agro-industries contribute a third of all exports (FAO, 2018). This indicates the agricultural sector's potential, but also that it is underperforming. Services are particularly important in Gaza, as Figure 10 demonstrates.

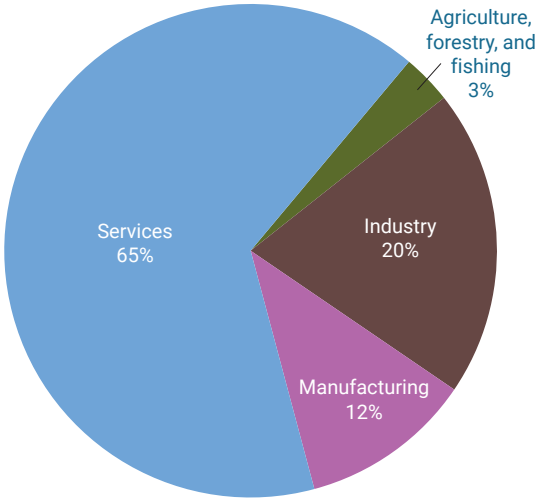

Figure 9
Structure of the economy, 2016 (World Bank, 2017)

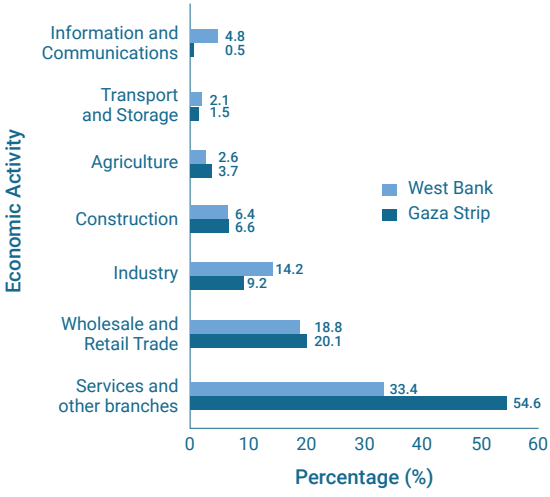

Figure 10
Percentage contribution* of economic activities to gross domestic product by region, 2017 at constant prices: base year 2015 (PCBS, 2018a).

4.2 Economy, unemployment and poverty

From a socioeconomic perspective, the constraints facing the Palestinian economy have created difficulties, including high rates of poverty (see table 3) and a very high unemployment rate. Poverty and unemployment are significantly higher in Gaza than in the West Bank.

Table 3: Individual poverty rates (percentage) according to household consumption in the occupied Palestinian territory by region, 2017 (PCBS, 2018b)

Region	Poverty	Poverty gap	Poverty severity	Deep poverty
Occupied Palestinian territory	29.2	7.9	3.1	16.8
West Bank	13.9	2.8	0.9	5.8
Gaza Strip	53.0	15.7	6.5	33.8
Urban	29.4	8.0	3.2	16.7
Rural	18.7	4.3	1.5	9.7
Refugee camps	45.4	13.3	5.4	29.3

In 2018, the total unemployment rate was 27.2 per cent, with 13.2 per cent in the West Bank and 48.2 per cent in the Gaza Strip (PCBS, 2018c). Restrictions on movement, gender inequality, and lack of labour market opportunities contribute to this high unemployment rate. Youth unemployment

continues to be a major concern, particularly in the Gaza Strip where more than half of those aged between 15 and 29 are out of work.

Despite high educational attainment rates, women's access to employment remains severely restricted. Palestinian women's labour force participation remains among the lowest in the world. Female labour force participation rates are especially low in East Jerusalem: in 2017, only 6.7 per cent of women were in the labour force, compared to 56.4 per cent of men (UNESCWA, 2019). Some 70 per cent of all women in Gaza are unemployed, resulting in female-headed households being more likely to face poverty and food insecurity. Poverty and a lack of economic opportunities also remain key factors behind violence against women in Gaza, while the humanitarian crisis has resulted in a large number of health issues for women (United Nations, 2019). The World Bank reports that the Palestinian labour market suffers from structural problems of inclusion particularly for women, and that social norms and mobility restrictions play a key a role in keeping women outside the labour market. Young people are also affected by very high unemployment (World Bank, 2017).

High rates of unemployment and poverty, combined with weak service distribution mechanisms, have an impact on the environment. The Palestinian Authority and service providers are accumulating debt for services delivered that are not paid for by consumers, which in turn contributes to lack of investment and inefficiency in such services. In the energy sector, low collection rates and high electricity losses in "special areas" such as refugee camps, and among Palestinian Authority institutions, has contributed to a lack of investment and may also negatively impact the payment behaviour of other customers (ESCWA, 2019). Cost recovery for solid waste disposal is a challenge for many local authorities, and open dumping is carried out in some areas because authorities cannot afford waste transportation to existing landfills (World Bank, 2019). Poorer households also tend to have weak waste water disposal systems: only 13 per cent of households in the poorest quintile are connected to sewer networks, compared with 42 per cent in the richest quintile (World Bank, 2019).

In light of current demographic trends, and high levels of unemployment and poverty, new sources of employment are urgently needed. By 2030, the Palestinian labour force will reach 2.3 million people – up from 1.3 million in 2015 (UNFPA, 2016). The United Nations Population Fund summarizes the conundrum of high demographic growth combined with economic constraints:

"The capacity of the Palestinian economy to cope with the size of the population and age structure… is governed largely by its labour market and employment. Employability and investment in human capital (such as health and education) also play an important role in this process. Given that 60 per cent of the land, 80 per cent of the water, and East Jerusalem (which constitutes 15 per cent of the Palestinian gross domestic product) remain under Israeli control, the Palestinian economy has very limited room for growth. Poverty remains a continuous challenge in the Palestinian context, staying high at 26 per cent and on the increase. This trend has resulted from erratic and declining economic activity, low wages, loss of employment opportunities due to the closure, reduced employment generation capacities of the public and private sectors, and restricted access to natural resources, as well as declining and unstable employment opportunities." (UNFPA, 2016)

4.3 Economy, environment and potential for green growth

The World Bank has emphasized, in light of weakening Palestinian economic activity, "the need for a more sustainable development path… in the medium-term" (World Bank, 2019). The World Bank has also noted that climate change "is likely to adversely affect future economic growth, livelihoods, and productivity potential in West Bank and Gaza," adding that such effects "are likely to magnify existing security threats and social instability and may severely diminish viable future economic development alternatives. Coupled with projected population growth and limited economic opportunities, the potential impacts of climate change could be severe" (World Bank, 2019).

Looking ahead, it will be important to identify areas for growth that will provide sustainable green jobs. This category includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through higher efficiency strategies; decarbonize the economy; and minimize or altogether avoid the generation of all forms of waste and pollution (UNEP, 2008).

Such jobs are central to achieving economic growth along with sustainable development (ILO, 2019).

The shift of the Palestinian economy towards service provision may have had some positive environmental consequences. Environmental emissions, waste generation and energy use per dollar output tend to be lower for services than for most manufacturing industries (Rosenblum, Horvath, & Hendrickson, 2000). Some traditional industries, such as stone-cutting and tanning, contribute to environmental degradation, particularly if they are not well regulated.

In seeking to develop the green economy, Palestinians can draw on relatively high levels of tertiary education, and high and growing human development indicators (see box 5).

Some progress has been made towards promoting green growth. In 2017, the Palestinian Authority launched a Sustainable Consumption and Production National Action Plan: this was one of the main outputs of the European Union-supported SwitchMed programme, and draws a roadmap for mainstreaming sustainable consumption and production in three sectors: tourism, housing and construction, and agriculture and food (EQA, 2016).

Investment in renewable energy is also increasing. One example is Massader, a subsidiary of the Palestine Investment Fund, which is currently building three utility-scale solar photovoltaic plants in Tubas, Jericho and Jenin, with a total generation capacity of 21.5 megawatts (Massader, 2017). Massader has also been selected by the Palestinian Ministry of Education and Higher Education to deploy solar photovoltaic systems on the rooftops of public schools and universities. The Palestinian regulatory framework is supporting such development: the three utility-scale photovoltaic plants, for example, are developed using the net metering scheme under the renewable energy law.

Given the constrained economic environment, major economic transformation remains challenging, as are the options to address very high unemployment rates. Options for promoting green growth include:

- Greening of the agriculture and fishing sector, helping the producers to meet sustainability standards and support for packaging, labelling and marketing "sustainably produced products" to bring Palestinian producers into the global supply chain;
- Focus direct spending on sustainable infrastructure (clean and renewable energy, clean water, sanitation, public transport, waste management and communication);
- Focus on making the traditional sectors more sustainable and cleaner to allow time for just transition; and
- Tackling existing constraints by proactively seeking partnerships from countries interested and able to invest in a green economy.

Significant constraints remain to promoting green growth, however. The investment environment remains difficult: investment continues to be forestalled both by existing restrictions and by the possibility that such restrictions might be further tightened.

Box 5: Palestinian human development indicators

The Human Development Index value for 2017 was 0.686, which put the State of Palestine in the medium human development category, 119 out of 189 countries and territories. Between 2005 and 2017, the State of Palestine's Human Development Index value increased from 0.657 to 0.686, an increase of 4.4 per cent. Between 1990 and 2017, Palestinian life expectancy at birth increased by 5.5 years, mean years of schooling increased by 1.3 years and expected years of schooling increased by 3.0 years. The State of Palestine's gross national income per capita increased by about 74.9 per cent between 1990 and 2017 (UNDP, 2018).

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Chapter 5: Drivers affecting the state of the environment

5.1 The concept of drivers affecting the state of the environment

UNEP uses the driving forces-pressures-state-impacts-response causal framework approach (see Introduction for more detail). This represents a systems-analysis view in which the **driving forces of social and economic development exert pressures on the environment,** which change the state of the environment. Drivers of environmental change are defined as "anthropogenic inertial forces – social, economic, ecological, technological, and political" (UNEP, 2019).

The changing state of the environment leads to impacts on human well-being and ecosystem health, which then produces human responses to remedy these impacts, such as social controls, redirecting investments, and/or policies and political interventions to influence human activity. Finally, these responses influence the state of the environment, either directly or indirectly, through the driving forces or the pressures. Existing policies should be assessed in terms of how they address the drivers and impacts of environmental challenges.

In analysing drivers of the State of the Environment in the occupied Palestinian territory, this report arranges drivers under the following headings: Climate change and underlying environmental conditions; Socioeconomic drivers; and environmental governance constraints.

5.2 Climate change and underlying environmental conditions

The occupied Palestinian territory is situated in the Eastern Mediterranean, which has been identified as a global climate change "hotspot": since the region is diverse and extreme climate conditions are already common, climate change impacts will be disproportionate (Lelieveld, et al., 2012). The higher temperatures and reduced precipitation that are expected as a result of climate change will aggravate water scarcity: this is described in more detail in Chapter 8. Higher temperatures and less water, in turn, contribute to further salinity and land degradation (David Gampe, 2016), pushing farmers to cultivate crops that are better adapted to saline conditions. This change in crop patterns has negative effects on the ecosystem and soil biodiversity.

In addition, to adapt to the decline in water supplies, some farmers use treated wastewater and brackish water, reduce crop density and cover the soil surface to decrease the impact of intensive rainfall on soil structure. Such practices reduce the amount of organic carbon in the soil and lead to declines in land productivity (Dudeen, 2002); (ARIJ, 2015).

Climate change is also expected to aggravate the problem of desertification. Approximately 45 per cent of the land area in the West Bank is prone to soil degradation due to steep hills. Arid areas are highly susceptible to water and wind erosion and salinization (Dudeen, 2002).

The underlying rock also influences land use and acts as a driver of environmental change. For example, the 24.5 km2 Sanur plain becomes flooded in winter due to the lack of water outlets, preventing its use for agriculture. In the Gaza Strip, where soil salinization is a problem, sand dunes and the light soil quality make soil management difficult (Dudeen, 2002).

Other potential climate change impacts include an increased frequency in natural disasters resulting from drought or extreme climatic events, such as storms, floods and heatwaves (UNDP, 2011). Storm surges and sea level rise may be particularly threatening to densely populated parts of Gaza, such as the Beach Camp. Sea level rise is also expected to lead to further contamination of the Coastal Aquifer (Abd-Elhamid, 2015).

Impacts of climate change exacerbate problems for human well-being, such as food and water security (David Gampe, 2016); (Froese, & Schilling, 2019). Since climate change will affect various regions differently, there is a need for integrated climate risk assessments, early warning systems and resilience building. Further details on climate change, carbon emissions, mitigation strategies and adaptation policies are dealt with in detail in Chapter 8 of this report.

5.3 Socioeconomic drivers

High population growth is often a significant driver of environmental change. Other things being equal, a larger population means higher consumption, which in the long run puts increased pressure on natural resources. Population growth can increase the strain on governance systems and contribute to rapid and unplanned urbanization. This, in turn, tends to lead to polluted, congested urban areas, where per capita use of natural resources is high (UNEP, 2019).

As described above, the Palestinian population growth rate is high, increasing at a yearly rate of 2.7 per cent. Population density is already very high in Gaza, and some areas of the West Bank, including East Jerusalem. Urbanization has occurred rapidly without adequate planning, as described in Chapter 9 of this report. Population and urbanization trends suggest that pressure on natural resources and delivery of services will continue to intensify. Growth of the settlement population further contributes to pressure on natural resources in the occupied Palestinian territory.

5.4 Environmental governance constraints

The political situation, particularly the continuing occupation and the *de facto* control of Gaza by Hamas, limits the policy space for sound environmental governance and impedes the use of best practice solutions to address natural resource scarcity and urbanization challenges. These factors affect the environment in the following ways:

- **Restrictions on Palestinian movement and access to land constrain natural resource management and contribute to high population density and poorly planned urbanization.** Gaza is a small, enclosed strip of land, and closures imposed by Israel severely limit the ability of its Palestinian residents to leave the Strip. Restrictions on the movement of Palestinian people and goods from Gaza, and between Gaza and the West Bank, were in place before Hamas took over *de facto* control in 2007; Israel tightened such restrictions after 2007, in the context of rocket attacks emanating from Gaza and repeated rounds of violence. In the West Bank, urbanization has been accelerated by the constraints Palestinians face relating to land-use planning. The area administered by the Palestinian Authority is mainly urban, with only a small area devoted to agriculture. In Area C, which represents over 60 per cent of the West Bank, Israel exercises full civil and military control. As described above, some "70 per cent of Area C has been unilaterally taken for exclusive Israeli use" (United Nations, 2016) and Israeli restrictions imposed on

much of Area C severely constrain potential for Palestinian development (World Bank, 2014).

- **Palestinian policymakers and professionals cannot employ best practice technological or environmental management solutions to address natural resource scarcity issues.** In Gaza, the use of best practice solutions to manage available freshwater, treat wastewater and manage solid waste is impeded both by the closure regime and by internal Palestinian divisions. Closure constrains the import of relevant technologies and energy. Also, as noted in Chapter 1, Hamas *de facto* control of Gaza means that Palestinian Authority institutions, including the Environment Quality Authority, can operate only to a limited extent in Gaza. The shortage of energy and waste management capabilities in Gaza has already contributed to a situation in which solid waste and wastewater is contaminating soil and groundwater, and the Mediterranean Sea (see Chapter 7 for details).
  Restrictions on the import of materials and technologies also impede the use of irrigation, which would otherwise enable efficient agriculture in situations of water scarcity. Restrictions on water use and the limited amount of space available for agriculture have also pushed Palestinian farmers in both the West Bank and Gaza to increase the use of chemical fertilizers and pesticides, which in turn has contaminated soils and groundwater (PCBS, 2010).
- **Lack of political progress has led to unclear and overlapping environmental governance arrangements.** Israel, as occupying power, has a responsibility to protect the environment in the occupied Palestinian territory. Palestinian institutions were also assigned responsibilities for environmental governance under the Oslo framework. Due to institutional constraints and other factors detailed in Chapter 1, the Palestinian Authority faces difficulties in applying Palestinian laws in Areas A and B. It is unable to apply these laws in Area C. Israel applies a different set of laws in settlements in the West Bank. In Gaza, the *de facto* authorities have appointed their own employees and established different administrative processes, and this constitutes another major impediment to coherent environmental governance and natural resource management.
  The simultaneous application of different sets of laws, and law enforcement capabilities, in the same territory, leads to enforcement gaps. The e-waste business described in Chapter 9 is one example.
- **Israeli security measures cause environmental change and degradation.** Israel has uprooted large numbers of trees (especially olive trees) in the occupied Palestinian territory (EQA, 2010) during the clearance of land for military outposts, buffer zones for settlements and bypass roads. During construction of the separation barrier in 2002, Israel uprooted thousands of trees and cleared agricultural land (ARIJ, 2007). By 2008, construction of the separation barrier and associated infrastructure had affected some 170,000 dunums (17,000 ha) of fertile agricultural lands, or 10.2 per cent of the total area cultivated in the West Bank (OCHA, 2015). Barrier construction has also disrupted ecosystems and impacted biodiversity (see Chapter 6), although Israel reports that it has taken measures to minimize the adverse environmental impact of the barrier, including the construction of wildlife passes, water conveyors and drainage solutions, and changes to the barrier route in ecologically sensitive areas. Herbicide spraying by Israeli aircraft around the Gaza perimeter also damages crops inside the Gaza Strip (FA, 2019).

5.5 Conclusion

The Palestinian environment is being degraded by the increasing impacts of climate change, population growth, and rapid urbanization. In the absence of sound environmental governance, pollution of the air and degradation of water and land are likely to continue and to intensify.

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Chapter 6: State of terrestrial and marine ecosystems and biodiversity

6.1 Introduction

According to the Convention on Biological Diversity, "Biological diversity means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. 'Biological resources' includes genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity." The loss of biodiversity makes ecosystems less resilient, threatening their ability to provide goods and services (United Nations, 1992).

6.2 Ecosystems status and trends

The occupied Palestinian territory contains diverse ecosystems despite its small geographical area. Such diversity arises from variations in topography and climate. As described in Chapter 2, the West Bank is divided into four major geomorphological areas: central highlands, semi-coastal region, eastern slopes region, and the Jordan Valley. The Gaza Strip is essentially a foreshore plain gradually sloping westward.

Ecosystem diversity
The ecosystems found in the occupied Palestinian territory include tree-covered areas, shrub-lands, grasslands, wetlands and the marine ecosystem (SP, 2015).
Tree-covered areas: Tree-covered areas occupy about 58,987,600 ha. Of these, approximately 7,830 ha are considered forests. Most of these forests were planted during the British mandate, although a small percentage was made up of remnants of natural forests.
Shrub-lands: The shrub-lands, which cover an area of about 38,500 ha, are very dynamic and host distinctive wildlife. The shrub-lands are one of the most sensitive habitats and comprise a wide range of plant species that have high economic value.
Grasslands: Grasslands cover about 42,500 ha and could be considered as natural grazing areas. These rangelands have been exposed to severe overgrazing for a long period of time, which has resulted in the disappearance of many palatable plant species and eventually in soil erosion (Mohammad, 2000).

Wetlands: There are only a few wetland zones in the West Bank. Some of these are seasonal, in that they are flooded in winter and dry up in the summer. These flood zones act as a refuge, feeding and resting stations for migratory waterfowl, and as a home for amphibians. Examples of these are the two flood areas of Wadi al-Bhadan and Wadi al-Muqatta'a in the Ramallah and Al Bireh Governorate, and Marj Sanour in the Jenin Governorate.

The main Palestinian wetland is Wadi Gaza. The source of Wadi Gaza is located near Al Samou' village south of Hebron. The course of the Wadi crosses the Naqab Desert and finally discharges into the Mediterranean Sea, south of Gaza City. The last 9 km of its course are within the Gaza Strip itself, making Wadi Gaza the largest valley in Gaza. The valley is considered an ecologically significant natural heritage area. It is one of the few remaining undeveloped areas in the Gaza Strip and acts as a natural habitat for migratory and endemic birds. Some bird species, ranked rare or endangered according to the International Union for Conservation of Nature, still find the valley an ideal place for feeding during migration (UNESCO, 2012).
Marine ecosystem: The marine habitat along the 42-kilometre-long Mediterranean coastline of Gaza is perhaps the most productive marine ecosystem in the Mediterranean, supporting very high population densities of epiphytic flora and fauna (Bassous/Ghattas, 2014). Palestinian fishing vessels are restricted to a maximum of 12 nautical miles off the Gaza coast – although Israel has often reduced this distance, citing security concerns (OCHA, 2019, February). The Marine Institute of International Fishermen has expressed concerns regarding the overfishing of pelagic and demersal fish by large international trawlers (Ali, 2002), which threaten the marine ecosystem off the Gaza Strip.

Figure 11
Wadi Gaza Coastal wetland location

Box 6: Impact of pollution from Wadi Gaza Coastal wetland on the Mediterranean Sea: a study by el-Hallaq

Wadi Gaza is considered one of the most important coastal wetlands in the Eastern Mediterranean Basin. In recognition of its importance as a natural area and as the only wetland in the occupied Palestinian territory, Wadi Gaza was declared a nature reserve in June 2000. The Ministry of Environmental Affairs requested that municipalities revise their land use plans to ensure that the Wadi bed be protected. However, Wadi Gaza is rapidly degrading due to anthropogenic activities including, but not limited to, discharge of municipal sewage, dumping of solid wastes, rampant use of pesticides and illegal poaching. These waste products form a river of untreated wastewater of more than 5 km long that discharges into the Mediterranean Sea. A study was performed using remote sensing and geographic information system tools to understand the effects of this wastewater on seawater pollution levels. The area of the watershed inside Gaza was estimated to be 58.792 km². The study showed that the total amount of contaminated water that flows into the sea can reach an estimated 146.5 mm³/year. The total area of coastal sea contamination reaches approximately 38.8 km² and is oriented to the north along the coastal shore. Its influence extends to Gaza Seaport, 10 km away from the Wadi.
The study results highlight the need to address the wastewater problem. A wastewater treatment plant is essential to serve the central area, and households should be connected to a pumping station in order to pump their sewage to this plant. Furthermore, studies should be carried out to assess the impact of contamination from Wadi Gaza on groundwater pollution levels as well as marine organisms and on people bathing in the sea (El-Hallaq, 2019).

Waste water pipe on the Gaza coastline, February 2019.
(UNEP, 2019)

Box 7: Flow of raw sewage from the Gaza Strip coast to the Israeli coast

(Based on a note from the Israel Ministry of Environmental Protection, September 2017, and United Nations information)

There is a relationship between the reduction in electricity supply to the Gaza Strip and the contamination of the coasts of Israel. The fragility of wastewater treatment facilities due to the 2009 hostilities in the Gaza Strip and military operation activities, low capacity of plants to treat excessive amounts of wastewater, improper operation of sewage systems and power outages have contributed to a situation in which approximately 80,000–100,000 m^3 of sewage, partially treated and raw wastewater, are released every day from sixteen sewage outfalls to the Mediterranean Sea.

Sewage treatment plants have been damaged by conflicts, and are affected by power outages and lack of adequate maintenance. On 13 November 2013, one of the main sewage pumping stations in Gaza City (which previously handled 60 per cent of the city's sewage) failed and discharged over 35,000 m3 of untreated sewage over a large area in the neighbourhood of Az-Zeitoun, south of Gaza City (OCHA, 2013). The Israel Oceanographic and Limnological Research and the Ministry of Environmental Protection monitored the sewage runoff, and a 2013 image shows high chlorophyll concentrations in the coastal region following the growth of micro-algae as a result of organic matter originating in effluents. In April 2017, a dispute between the Palestinian Authority and Hamas led to the shutdown of the Gaza Power Plant. The following month, the Palestinian Authority notified Israel that it would reduce its monthly payments for electricity Israel provides to Gaza, leading Israel to temporarily reduce the supply of electricity to the Gaza Strip until payments were restored in early 2018. Satellite imagery from 13 June 2017 clearly shows the high concentration of suspended particulate matter flowing from the Gaza coastline and moving northward towards the shores of Ashkelon.

The influx of raw sewage at the Zikim and Ashkelon beaches endangers beachgoers and often leads to beach closures. It affects the Israel-based VID desalination company technically and economically, and has caused it to shut down for several days. Consequently, the desalination plant requested approval to use additives that could slow down the damage to the desalination membranes. These additives, which are damaging for the marine environment, are released into the sea together with the brine waste of the desalination plant.

Furthermore, the wastewater contains organic material that could cause toxic algal blooms in the marine environment, increasing fish mortality and the accumulation of toxins in marine invertebrates such as oysters and crustaceans, as well as odour nuisances. The discharge of raw or partially treated sewage into the Gaza sea continues and flows northward with the current, reaching Ashkelon and the desalination plant in the southern shores of Israel.

The main source of pollution is the discharge of untreated wastewater and dumping of waste along the beach in north, central and southern Gaza. This pollution has resulted in major health problems for both terrestrial and marine life, as well as a reduced quantity of fish (SP, 2015).

Species diversity

Flora: Over 2000 plant species and 54 endemic flora species have been recorded in the occupied Palestinian territory (SP, 2015).

Table 4: Endemic rare and endemic very rare plant species in the occupied Palestinian territory (ARIJ, 2015)

Endemic species	Family	Agroecological region	Status
Alcea rufesens	Malvaceae	JV	R
Anthemis edumea	Compositae	JV	R
Filago inecpectata	Compositae	CH, SC, JV	R
Centaurea ascalonica	Compositae	CH, ES, Gaza	R
Iphiona maris-mortui	Compositae	JV	R
Cephalaria tenella	Dipsacaceae	CH	R
Bellevalia zoharyi	Liliaceae	ES	R
Galium heirochuntinum	Rubiaceae	JV	R
Kickxia judaica	Scrophulariaceae	ES, JV	R
Reseda urnigera	Resedaceae	ES, JV	R
Reseda maris-mortui	Resedaceae	ES, JV	R
Salvia eigil	Labiatae	CH, SC	VR
Stachys zoharyana	Labiatae	CH	VR
Orchis israelitica	Orchidaceae	CH	VR
Amygdalus ramonensis	Rosaceae	CH	VR
Ferula samariae	Unbelliferae	CH, ES	VR

Note: R: rare, VR: very rare, CH: central highlands, SC: semi-coastal, ES: eastern slopes, JV: Jordan Valley

Table 5: Fauna species inhabiting occupied Palestinian territory in numbers (sources: Palestinian Authority and ARIJ, 2015)

Fauna species	Number
Birds	373
Mammals	92
Amphibians	5
Reptiles	81
Fish	297
Invertebrates	30,000
Total	30,848

Fauna: The occupied Palestinian territory has a vast variety of wildlife and is home to the six main different groups of fauna: birds, mammals, reptiles, amphibians, fish and invertebrates (ARIJ, 2015).

Table 6: Fauna species found exclusively in Palestine and Israel (LNT, 2019)

Fauna	Endemic species	Genus	Common name	Source
Mammal	*Crocidura ramona*	*Eulipotyphla - Soricidae*	Negev shrew	(ASM, 2019)
	Gazella acaciae	*Artiodactyla - Bovidae*	Acacia gazelle	(Lynx, 2019)
Reptile	*Acanthodactylus beershebensis*	*Squamata Sauria - Lacertidae*	Be'er Sheva fringe-fingered lizard	(Uetz, 2013)
Amphibian	*Latonia nigriventer*	*Anura - Alytidae*	Hula painted frog	
	Hyla heinzsteinitz	*Anura - Hylidae*		
Fresh water fish	*Tristramella sacra*	*Cichlidae*	Long-jaw tristram tilapia	(Fricke, Eschmeyer, & Van der Laan, 2019)
	Acanthobrama telavivensis	*Cyprinidae*	Yarkon bream	
	Mirogrex hulensis	*Cyprinidae*	Hula bleak	
Marine fish	*Gymnapogon melanogaster*	*Apogonidae*		(Froese & Pauly, 2019)
	Didogobius bentuvii	*Gobiidae*	Ben-Tuvia's boby	
	Opua elati	*Gobiidae*		
	Priolepis Goldshmidtae	*Gobiidae*		
	Panturichthys fowleri OC	*Heterenchelyidae*		
	Cirrhilabrus blatteus	*Labridae*	Purple-boned wrasse	
	Heteronarce bentuviai	*Narcinidae*	Elat rlectric ray	
	Canthigaster pygmaea OC	*Tetraodontidae*	Pygmy toby	
	Vanderhorstia opercularis	*Gobiidae*		(Fricke, Eschmeyer, & Van der Laan, 2019)
	Gymnothorax baranesi	*Muraenidae*		
Vertebrate		*Latonia*	Amphibian anura alytidae	(LNT, 2019)

OC = A fish base occurrence record suggesting a specimen is from another country outside its normal stated range (LNT, 2019).

Species abundance

Along the Gaza Strip Mediterranean shores, 201 fish species have been recorded (Ali, 2002). The majority of the species are bony fish (81 per cent). Of the bony fish, 56 per cent are common, 36 per cent are rare, and 8 per cent are very rare species. Of these observed bony fish 7.4 per cent are migratory species that are not present in Gaza Strip waters year-round. Approximately 15 per cent of the bony fish are immigrants from the Red Sea, among them four new species have been recorded in Gaza Strip waters. The record of one specimen of painted sweet lips *(Diagramma pictum)* may be evidence of a new immigrant for the Mediterranean Sea (Ali, 2002).

Red list species

Table 7 shows the number of threatened and endangered fauna in the occupied Palestinian territory and neighbouring countries.

Agrobiodiversity

The occupied Palestinian territory is part of the Fertile Crescent, where wheat was first domesticated. That success was momentous as the high protein content of the cereal is credited as foundational to the great accomplishments of early Western civilizations (Diamond, 2002).

The wild ancestors of these crops represent a vital resource for future crop breeding (SP, 2015). They are essential components of natural and semi-natural habitats as well as agricultural systems and are critical for maintaining ecosystem health. Their conservation and sustainable use are essential for improving agricultural production, increasing food security and maintaining environmental benefits. The germplasm conserved in gene banks is especially rich in wild relatives of crops, traditional farmer cultivars and old cultivars, which represent an immense reserve of genetic diversity (Al-Atawneh, Amri, & Maxted, 2013).

Continued natural habitat destruction, overuse of vegetation cover and the loss of valuable plant

Table 7: Numbers of threatened species (critically endangered, endangered and vulnerable categories only) in Palestine and neighbouring countries by each major taxonomic group (IUCN,2019)

Country	Mammals	Birds	Reptiles	Amphibians	Fishes	Molluscs	Other invertibrates	Plants	Fungi & protists	Total
Egypt	18	14	13	0	60	0	56	8	0	169
Israel	15	18	11	1	58	11	63	27	1	205
Jordan	13	14	6	0	22	6	55	8	0	124
Palestine	4	15	4	0	2	2	2	10	0	39
Syrian Arab Republic	14	17	9	0	51	9	13	31	0	144

Box 8: Key biodiversity facts and figures (SP, 2015)

- There are approximately 51,000 living species in the occupied Palestinian territory, constituting approximately 3 per cent of global biodiversity. There are more than 30,850 animal species, consisting of an estimated 30,000 invertebrates, 373 birds, 297 fish, 92 mammals, 81 reptiles and 5 amphibians. Of the 1,938 wild plant species in the occupied Palestinian territory, 102 (5.3 per cent) are classified as endangered species and make up the "red list". These species belong to 83 genera and 39 plant families. 39 plant families 5.3 per cent (Ali-Shtayeh & Jamoous, 2018). The occupied Palestinian territory has 54 endemic plants that do not exist in any other part of the world.
- Based on the International Union for Conservation of Nature global guidelines, criteria and Red List publications, there are 24 species in the occupied Palestinian territory listed as globally threatened. From these 24 species, there are 10 birds, 4 reptiles, 3 mammals, 2 fish, 2 molluscs, 1 amphibian, and 2 other invertebrate species. There are no plant species recorded listed on the International Union for Conservation of Nature Red List.
- The country is rich in biodiversity including more than 50 sites which have been identified as key biodiversity areas. These sites were included in the National Spatial Plan for protection from any change or future land use. With regard to natural reserves, Israel has designated 48 natural reserves in the West Bank.
- As a result of a systematic review conducted by the Biodiversity and Environmental Research Centre in 2014, a National List of Medicinal Plants in the State of Palestine was prepared. This list comprises more than 368 plant species.
- In terms of agrobiodiversity, the occupied Palestinian territory, as part of the Fertile Crescent, is an important centre of genetic diversity for a wide range of crops that were domesticated approximately 10,000 years ago. The wild ancestors of wheat, barley, vines, olives, onions and pulses crops, which now only occur in tiny remnants of natural vegetation, represent a vital resource for future crop breeding.

genetic resources are threatening the sustainability of the livelihoods of local herders and their pastoral communities. Unfortunately, landraces and wild relatives of these and other species are only found in small remote areas and remnants of natural vegetation. Local agrobiodiversity is affected by the prevailing governance situation, which has reduced the grazing area, causing serious overgrazing in limited accessed rangelands (see also Chapter 10 of this report) (Amri, et al., 2013).

Food demands and market forces have encouraged the replacement of the locally adapted varieties of fruit trees, vegetables and field crops with higher-yielding cultivars, hence hampering the gene pools of crops (Allahham, & Hasasneh, 2013).
The Palestinian Ministry of Agriculture, in April 2005, issued the *National Policy and Legislation for Promoting the Conservation of Agrobiodiversity.* The ministry implements the Palestinian Authority's agrobiodiversity policy on the ground, and some of the biodiversity aspects in coordination with the Environment Quality Authority. This function is delegated to the Department of Nature and Forests under the Directorate of Forests, Rangeland and Wildlife. The local communities are engaged and considered principal stakeholders in protected areas management and conservation of biodiversity by the Environment Quality Authority (SP, 2015).

Soil biodiversity
Soils are a globally important reservoir of biodiversity and contribute to ecosystem services. Many thousands of species of animals and microorganisms live in soils, ranging in size from the almost invisible microbiota (e.g. bacteria, fungi and protozoa) to the more conspicuous macrofauna and megafauna (e.g. earthworms, termites, millipedes, moles and rats). Information and research available on microbes, microfauna, mesofauna and macrofauna, comprising the vast biodiversity of soil, are very limited.

Ecosystem goods and services
The health of the ecosystems in the occupied Palestinian territory and human well-being are interrelated. The ecosystem includes forested

areas, shrub-lands, grasslands, wetlands, and the marine ecosystem. These ecosystems provide a full array of goods and services upon which people depend for their livelihoods and well-being. The main services include food, medicine, fuel, water purification, pest control and climate regulation, in addition to intangible services such as aesthetics, cultural heritage and recreation (Bassous/Ghattas, 2014). However, there is no reliable and accurate data set available to provide an economic valuation of the ecosystem goods and services in the occupied Palestinian territory.

6.3 Pressures and impacts

Biodiversity threats include human settlements, distribution of industrial factories, overgrazing, overfishing, desertification and drought, pollution and contaminants, hunting, and climatic and environmental changes. Such factors are causing direct changes in plant and animal species composition, and contributing to the disappearance of species (Thawaba, et al., 2017). The International Union for Conservation of Nature Global Invasive Species Database describes five invasive species (Crocidura suaveolens (lesser white-toothed shrew), Eichhornia crassipes (water hyacinth), Iris pseudacorus (yellow flag iris), Lythrum salicaria (purple loosestrife), Setaria verticillata (bur bristle grass) found in the occupied Palestinian territory (IUCN, n.a.).

In an analysis of threats affecting biodiversity, the Palestinian Environment Quality Authority described the adverse impact of habitat fragmentation, desertification, land degradation, over-grazing and soil erosion, urbanization, removal of rocks for construction, uprooting trees, invasive species, pollution and climate change. Habitat fragmentation, urbanization and barrier construction are considered by the Environment Quality Authority to pose “very high”

Box 9: The impact of the separation barrier on biodiversity: Palestinian Environment Quality Authority assessment and Government of Israel mitigation measures

Since 2002, land expropriation by Israel and construction of the separation barrier has been a driving factor of environmental degradation, particularly for biodiversity. The following points summarize the impacts of this construction on the Palestinian environment, and its fauna and flora. More details can be found in the Environment Quality Authority report (EQA, 2010):

- Destruction of the natural habitat in large areas, since the separation barrier forms a physical impediment in the terrestrial ecosystem;
- Fragmentation of ecosystems and habitats, which can isolate and limit the movement of land animals and access to their habitats;
- Removal and clearing of natural vegetation cover from wilderness areas through which the separation barrier passes. This deprives wildlife of sources of food and shelter; and
- Habitat destruction and fragmentation affect all ecosystem goods and services (EQA, 2010).

The Environment Quality Authority assesses that construction of the separation barrier may result in significant, long-term environmental impacts. Habitat fragmentation of both flora and fauna reduces genetic diversity. The remaining small populations are then vulnerable to all the problems associated with rarity: genetic deterioration from inbreeding, random drift in gene frequencies, and environmental catastrophes. As a result of both construction activities and the long-term existence of the separation barrier, populations of resident species will be and are being impacted. During the construction process, large areas were deforested, and tens of thousands of trees were uprooted. Such pressure on the integrity of an ecosystem and the stability of natural resources increases risks to livelihoods and to the historical, cultural, environmental and economic value of Palestinian biodiversity (SP, 2015).

The Government of Israel reports that it has taken measures to minimize the impact of the barrier on biodiversity and nature, including replanting of trees and the creation of wildlife passes for reptiles and gazelles. It also reports that changes to the route of the barrier were made in ecologically sensitive areas (GoI, 2019).

threats to biodiversity in the West Bank. In Gaza, desertification, soil erosion, land degradation, overexploitation and pollution are assessed to pose "very high" threats to biodiversity (SP, 2015).

Table 8: List of protected areas transferred to the Palestinian Authority under the Oslo Accords, and their IUCN criteria. (Qumsiyeh & Amr, 2018).

6.4 Responses

Protected areas

In the occupied Palestinian territory, the Palestinian Authority has identified more than 50 sites as key biodiversity areas; these sites are included in the National Spatial Plan for protection from

Protected area	Governorate	Area (Dunum)	Habitat type	International Union for Conservation of Nature	Criteria type
Al Qarin				I	Strict nature reserve
Al-Hashmee	Ramallah	200	*Pinus halepensis* and *Arbutus* and rachnae woodland	I	Strict nature reserve
Deir Ammar	Ramallah	120	*Pinus halepensis* woodland	III or no PA at all	Natural monument
Deir Razeh				IV	Managed reserve
Ein Darra	Ramallah	250	*Quercus calliprinus* woodland on limestone	IV	Managed reserve
Ein El-Uja				IV	Managed reserve
Fahmeh	Jenin	400	Semi-steppe batha	IV	Managed reserve
Jabal-Alkabeer	Nablus	9,500	Semi-steppe batha	IV	Managed reserve
Jerusalem Wilderness	Hebron and Bethlehem	172,500	Steppe vegetation	IV	Managed reserve
Sheikh Katrawny	Ramallah	11	*Quercus calliprinus* woodland on limestone	III or no PA at all	Natural monument
Sheikh Zeyd	Nablus	52	*Quercus calliprinus* woodland on limestone	III	Natural monument
Shoubash	Jenin	5,000	*Ceratonia siliqua* and *Pistacia lentiscus* forest	IV	Managed reserve
Sirris	Jenin	1,118	*Quercus calliprinus* woodland on limestone		
Sirris				I	Strict nature reserve
Suba				I	Strict nature reserve
Tammoun	Tubas	4,300	Semi-steppe batha	IV	Managed reserve
Tayyasir	Jenin	1,200	*Ceratonia siliqua* and *Pistacia lentiscus* forest	IV	Managed reserve
Um Al-Saffa				IV	Managed reserve
Um-Altutt	Jenin	320	*Quercus calliprinus* woodland on limestone	IV	Managed reserve
Wadi Al-Dilb	Ramallah	800	*Quercus calliprinus* woodland on limestone	IV	Managed reserve
Wadi Al-Quff				V	Protected landscape
Wadi El-Qilt				IV	Managed reserve
Wadi Zarqa Al-Elwey	Salfeet	2,700	*Quercus calliprinus* woodland on limestone	IV	Managed reserve

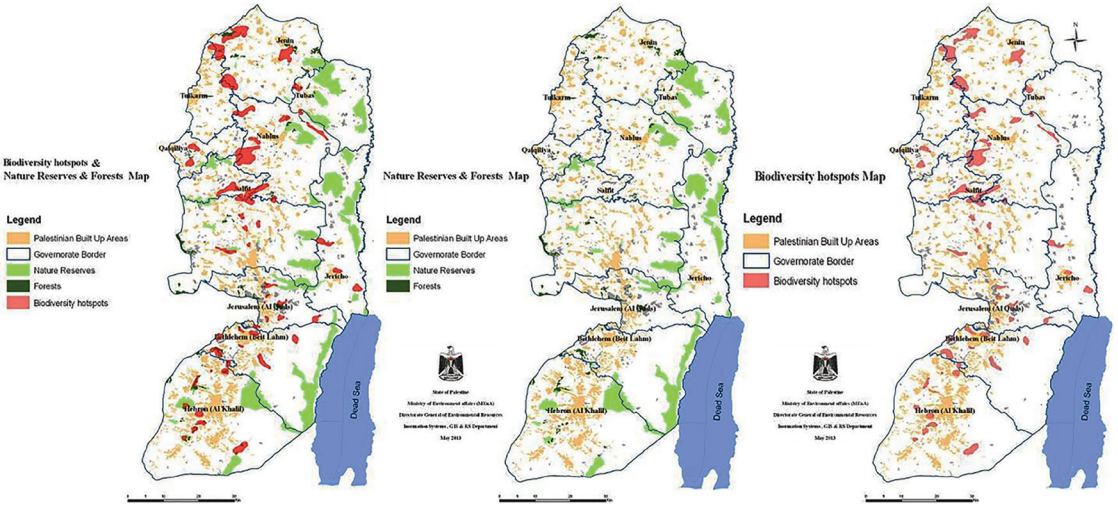

Figure 12
From left to right: West Bank biodiversity hotspots, with nature reserves and forests; West Bank biodiversity hotspots; West Bank nature reserves and forest (SP, 2015).

any land-use change (SP, 2015). Among the aforementioned sites, 13 are in Areas A and B. The Israeli authorities transferred jurisdiction for 19 distinct protected areas to the Palestinian Authority under the Oslo Accords (Table 6). The protected areas are categorized according to guidance by the International Union for Conservation of Nature. The International Union's guidelines provide definitions, management categories and governance types for the protected areas (IUCN, 2008) (IUCN, 2013). Of the 22 evaluated protected areas, one was listed under category V as protected landscape, three under category III as natural monuments, four under category I as strict protected areas, and 14 under category IV as managed reserves (Qumsiyeh, & Amr, 2018).

Conservation and management of wildlife

There are two small zoos in the West Bank, and another in Gaza that was damaged during conflicts. The wildlife Treasures Garden, which is managed by the Palestine Wildlife Society, aims to raise public awareness of wildlife conservation and protection. In addition, the non-governmental Biodiversity & Environmental Research Centre (BERC) established the BERC-Til Botanic Gardens in 2003. The Biodiversity & Environmental Research Centre has a herbarium which contains a wide range of plants from the occupied Palestinian territory, with approximately 1,030 herbarium specimens from 776 plant species which belong to 437 genera and 108 families (SP, 2015).

Institutional arrangements for the conservation of biodiversity

The Environment Quality Authority is responsible for:

- Implementing the Biodiversity Convention;
- Coordinating all programmes related to the environment implemented by other agencies;
- Formulating and implementing policy plans and programmes related to the conservation of biodiversity;
- Formulating regulations and creating guidelines on the environment; and
- Carrying out studies, research, surveys, publication of extension materials and conducting training programmes related to the conservation of biodiversity.

The Ministry of Agriculture, another institution with responsibility for the protection of biodiversity, undertakes the following:

- Formulating policy and plans related to natural resources and land use management;
- The Rangelands and Forests Directorate at the ministry is responsible for the management, control, utilization and conservation activities of national forests, and the improvement and management of protected areas;
- Developing of a seed gene bank through the National Agricultural Research Centre of the ministry; and

- The Extension and Applied Research Directorate plans to establish a new field gene bank where fruit trees are grown for the preservation and rehabilitation of existing types.

The Palestinian National Spatial Plan "reserves" protected area lands from other development.

Non-governmental organizations: Registered non-governmental organizations address a variety of environmental issues. Although most non-governmental organizations are not involved in conservation management activities, many are initiating public awareness programmes to increase understanding of the need to conserve biodiversity, use biological resources in a sustainable manner and promote income generation activities based on biodiversity (Al Mubarak, & Alam, 2016).

Israeli Civil Administration and Natural and Parks Authority: The Israeli Civil Administration also deploys a staff officer for nature reserves and national parks, because "Israeli law does not apply" in the West Bank. The staff officer for the nature reserves and national parks operates under Military Order 373 (1970), which states that "once an area in Judea and Samaria has been declared a park, it is the duty of the commander of the area to appoint an authority to manage its affairs (section 4), such as determining rules of conduct in parks, carrying out various construction activities, setting entrance fees and appointing inspectors (sections 5-7)" (GoI, 2019). The Israeli authorities state that "The core issues related to the conservation of biodiversity are part of the Nature and Parks Authority's policy: preservation of habitats, conservation of species and special or threatened populations… habitats are threatened by growing infrastructure, agriculture and pollution. As a result, unique populations are damaged and their numbers are decreasing (e.g., Bonelli's eagle, Golden eagle)." (GoI, 2019). According to the Israeli authorities, the Israeli Nature and Parks Authority also monitors sections of the separation barrier to collect data on wildlife in the area (GoI, 2019).

Policies and legislation

There are only limited provisions in the Palestinian Environmental Law No. 7 (1999) that deal with biodiversity. Furthermore, the existing provisions related to biodiversity are inadequate to ensure compliance with the resolutions and obligations of the Convention on Biological Diversity, which provides a basis for a national legislative framework for biodiversity conservation.

There are many factors that impede the enforcement of legislation relating to biodiversity, including a lack of experienced staff, financial and technical capacity of responsible departments, and unclear enforcement procedures for existing legislation. Under the umbrella of the general Palestinian government policies, there are a number of more specific policies, programmes and plans that either deal directly with biodiversity conservation and protected areas, or are of immediate concern (SP, 2015). Enhanced management of zoos would help to ensure they do not house wild animals in unnatural habitats (cages) but instead act as educational centres for conserving wild animals.

International targets and agreements

The State of Palestine ratified the Convention on Biological Diversity and the Cartagena Protocol on Biosafety. The Palestinian Government is committed to the implementation of the provisions of the Convention but has not ratified the Nagoya Protocol on Access and Benefits Sharing of Genetic Resources. The Environmental Law does not have any provisions relating to the Cartagena Protocol on Biosafety or the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. There are no additional Palestinian national legislation or administrative mechanisms pertaining to biosafety, nor access to genetic resources or associated traditional knowledge and benefit-sharing from their utilization. This is considered a key constraint towards achieving more meaningful benefit-sharing (SP, 2015). Although the updated Palestinian national biodiversity targets related to the Convention on Biological Diversity Aichi Targets (see box 10) and their related indicators are still not developed, a national biodiversity stakeholder consensus was undertaken on what has been done with regards to achieving the different Aichi Targets since their adoption in 2010. Figure 13 shows where Aichi targets are yet to be achieved.

Transboundary wildlife and biodiversity management

Transboundary management can be an effective tool to ease tensions and build confidence. To sustain such efforts, transboundary cooperation requires political support, leadership, stakeholder participation and secure funding, among other factors. While there has been some progress in promoting work across geographic boundaries,

Figure 13
Percentage of progress towards achieving Aichi Targets in the occupied Palestinian territory (SP, 2015)

Box 10: Aichi Biodiversity Targets

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society
Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use
Strategic Goal C: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity
Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services
Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity-building

many challenges still need to be overcome to achieve successful implementation of these efforts (Krafte, et al., 2017).
The States of Palestine and Israel are party to several multilateral environmental agreements of special relevance to conservation and sustainable development, and which have an important regional significance (table 9).

6.5 Conclusion and suggested actions

In recent decades, rapid population growth, the growth of settlements, land-use changes and the unsustainable use of natural resources have put severe pressure on ecosystem goods and services in the occupied Palestinian territory. These factors collectively present mounting challenges to efforts to maintain healthy ecosystems, conserve biodiversity and prepare for the adverse effects of climate change.

The Palestinian Authority has responded to these challenges through various measures. It has made efforts to expand the protected area network, foster scientific research and education, and commit to international mechanisms to conserve biodiversity. Further progress is required, particularly in the control of overgrazing in the West Bank, the expansion of gene banks, and the stakeholders' alliance for the conservation of their shared natural heritage. Further suggested actions are:

- Updating existing Palestinian National Biodiversity Strategy and Action Plan; and
- Addressing gaps in existing national legislation regarding biodiversity, protected areas, biosafety and intellectual property rights, and harmonizing existing legislation and policies through a comprehensive review and assessment.

Table 9: Party status – multilateral environmental agreements (InforMEA, 2019)

Treaty	Palestine	Israel
Agreement on the Conservation of African-Eurasian Migratory Waterbirds	-	Ratification
Cartagena Protocol	Accession	
Convention on Biological Diversity	Accession	Ratification
Convention on International Trade in Endangered Species of Wild Fauna and Flora	-	Ratification
Convention on Migratory Species	-	Party
Barcelona Convention	-	Ratification
Land-Based Sources Protocol	-	Ratification
Specially Protected Areas and Biodiversity Protocol	-	Ratification
Ramsar Convention	-	Ratification
United Nations Convention to Combat Desertification	Accession	Ratification

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Chapter 7: Water resources management

7.1 Introduction

Freshwater resources in the occupied Palestinian territory include both groundwater (aquifers) and surface water resources (rivers, streams, lakes and springs). Access to, and management of, the hydrological network of the region is complicated by the environmental governance challenges described in Chapters 1 and 5 above.

There are different sets of figures on the water sector, and there are discrepancies between these figures. UNEP is not currently in a position to independently verify the accuracy of different sets of water data. Other international organizations active in the water sector in the occupied Palestinian territory, including the World Bank and the Food and Agriculture Organization of the United Nations, have provided extensive analysis of water resources management and trends, and this Chapter draws extensively on figures and analyses provided by these organizations. Where Israeli or Palestinian data have been used, this is clearly specified.

7.2 Status and trends

Hydrological basins and surface water resources
Three major drainage basins are found in the West Bank: the Western Basin, the Northeast Basin, and the Eastern Basin. Gaza is part of the coastal basin and underlain by the Coastal Aquifer (Weinberger, et al., 2012). Surface water resources in the West Bank consist of the Jordan River and mostly ephemeral wadis flowing towards the Mediterranean, the Jordan Valley and the Dead Sea. In the Gaza Strip, the only significant surface water feature is the Wadi Gaza, which is now mostly dry, other than during periods of heavy rainfall and resultant flash flooding (Thawaba, et al., 2017); (UNESCO, 2012).

The Jordan River is the largest permanent river and most important surface water resource in the region. The Jordan flows from north to south from an elevation of 2,200 m above mean sea level at Jabl el-Shaykh (Mount Hermon) to approximately 430 m below sea level at the Dead Sea. It originates from the Hasbani in southern Lebanon, and the Banias and the Dan at the base of Jabl el-Shaykh, which merge at a point five kilometres south of

the Blue Line (i.e. the demarcation line between Lebanon and Israel), then flow south through the Hula Valley to join Lake Tiberias. The Lower Jordan River receives water from the Yarmouk River along with the outflow from Lake Tiberias. The full length of the meandering Jordan River is 360 km, with a surface catchment area of 18,300 km2. Over the last 50 years, at least 95 per cent of Jordan's natural flow of 1.3 billion cubic metres has been diverted (Swagerty, 2014). The River Jordan's regional riparians include Israel, Jordan, Lebanon, Palestine and Syria (FAO, 2008).

The Dead Sea is essentially a salt lake with no outlet. Reduced input from the Jordan River has led to a major decline in its elevation, as well as its surface area, which has shrunk by nearly half over the last century. The water level of the sea is dropping at a rate of around 1 metre per year (Schwartz, 2018).

The West Bank also contains 10 to 15 major streams that either drain toward the Mediterranean Sea in the west or the Dead Sea/Jordan River system in the east (ARIJ, 2015). These wadis, although seasonal, provide a small percentage of the freshwater for human use, and there are also a limited number of impoundments near villages where such water is collected for agricultural, drinking and sanitary purposes.

There is potential to build dams on the major wadis of the West Bank such as El-Faria, El-Auja and Qilt, which drain significant runoff amounts to the Dead Sea basin. Initial investigations showed the possibility of utilizing 13 mcm per year of runoff water by constructing dams on these wadis (FAO, 2008). For example, the Al 'Auja earthen dam, with a storage capacity of 700,000 m3, is located west of the Al 'Auja village, within a watershed of some 45 km2 (18 km long and 2.5 km wide). The entire catchment area has an average flow of 2 to 3 mcm of water per year (ARIJ, 2015). An environmental impact assessment should be carried out before commencing any such work.

Groundwater (aquifers)

The limestone hills of the West Bank act as a porous sponge which absorbs rainwater, and much of this emerges as springs in valleys and along the margins of the highlands both east and west. Groundwater is found in shallow, intermediate and deep aquifers within a series of rock formations dating back to the Jurassic and Cretaceous periods. These rock formations are exposed at the surface throughout the West Bank and constitute recharge areas for this entire hydrological system (FAO, 2008).

The Mountain Aquifer covers some 4,000 km² (Hassouna & Sinclair, 2013) and is underlain by three major hydrological basins and their related aquifers, as follows:

- The Northeast Basin, with a groundwater flow direction of north-northeast. To the north, the basin is bordered by the Harod and Beit-She'an valleys and the western, southern and eastern borders lie within the Jibal Nablus (Samarian Hills);
- The Eastern Basin flows eastward with the western border of the basin approximately following the surface water divide along the ridge of the Jibal Al Khalil - Jibal Nablus, while the eastern border is the Jordan Valley. To the south, the basin runs past the southern Hebron Hills and the northern boundary of the basin occurs near the Fara Graben; and
- The Western Basin (Ras al-Ain Timsah or Yarkon-Taninim basin) is the portion of the Mountain Aquifer that flows westward. The basin extends in the east from the water divide in the hills, to the Mediterranean Sea in the west, in the north to the Yizrael Valley and in the south into the Sinai Peninsula (Weinberger, et al., 2012).

The Gaza Strip is underlain by the Coastal Basin or Aquifer that runs from the Carmel Range in the north to the Sinai Peninsula in the south. This highly permeable, shallow coastal aquifer is of sandy/sandstone composition and is divided into three sub-aquifers that overlie each other. The thickness of the Coastal Aquifer varies throughout the region, gradually increasing from about 5 to 60 m in the east to about 10 to 160 m in the west along the coast (FAO, 2008). The Mountain Aquifer sub-basins are illustrated in Figure 14.

Water production and supply

The three major basins that comprise the Mountain Aquifer have a combined annual sustainable yield of around 675 million cubic metres (mcm). The limestone hills of the West Bank contain 95 per cent of the Mountain Aquifer feeding basin and 80 per cent of its stocking basin (Hassouna & Sinclair, 2013).

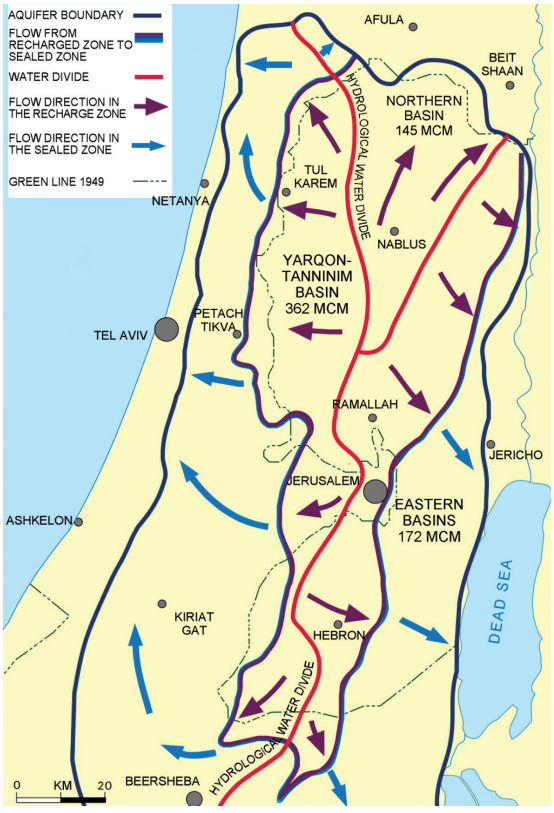

Figure 14
The three Mountain Aquifer sub-basins (IWA, 2009)

The Western Basin produces approximately 360 mcm annually and contains the highest quality water. The North-eastern Basin produces approximately 145 mcm annually, also of high quality and with the most productive springs located in Israel (Eran, Bromberg, & Giordano, 2018). The Eastern Basin produces approximately 170 mcm annually with the largest springs issuing within the West Bank.

The water from these locally important springs is mostly used for agricultural and domestic purposes. Cisterns and open ponds have been constructed to capture rainwater, which is used by many Palestinians, particularly in areas that lack distribution networks. The harvested quantity of water in the domestic cisterns is estimated to be between 0.75 mcm and 4 mcm in the agricultural ponds (ARIJ, 2015). According to Thawaba et al. (2017), the discharge amount from a total of between 300 to 400 springs in 2011 was 21.3 mcm. This amount increased to around 40 mcm in 2012, 2013 and 2015, but according to Palestinian Water Authority figures stood at 23.5 mcm in 2017.

The annual replenishment of the Coastal Aquifer underneath the Gaza Strip is 55 mcm, some 40 per cent of which is assured by local rainfall, while irrigation, leakage from deficient distribution networks and wastewater contribute to around 60 per cent of its replenishment (Hassouna & Sinclair, 2013).

Renewable water resources

According to World Bank (2018a) figures:

- A total of 48 mcm per year is supplied in the West Bank through groundwater and other naturally occurring resources such as streams and springs, and 84 mcm is supplied via groundwater and natural resources in the Gaza Strip;
- 95.4 per cent of water available for use in Gaza stems from groundwater, 2.6 per cent from water that has been desalinated and the remaining 2 per cent is purchased from Mekorot, the Israeli water company;
- 64 per cent of water available for use in the West Bank stems from groundwater and the other 36 per cent is purchased from Mekorot; and
- A minimal percentage of water used in the West Bank stems directly from surface waters (World Bank, 2018a).

Allocation of water

During the Oslo process, Israel and the Palestine Liberation Organization identified water as a final status issue, allocation of which would be resolved via the envisaged comprehensive peace agreement. The 1995 Interim Agreement clarified that the Palestinians had water rights, though the extent of such rights was not specified. In 1995, the parties agreed to coordinate the use of shared waters. Annex III, Appendix 1, Article 40 of the Interim Agreement (Oslo II) sets out these arrangements; they were (like other aspects) envisaged as temporary.

Of the total “estimated potential” of the three aquifers, 483 mcm was allocated to Israel (71 per cent) and 138 mcm was allocated to the Palestinians (20 per cent). Of the Palestinian share, 20.5 mcm was to come from “additional wells” yet to be developed. The balance of 57 mcm was left “to be developed” from the Eastern Aquifer (see table 10) (World Bank, 2018b).

Table 10: West Bank: allocation of water resources of the three shared aquifers under Article 40 of the Oslo II Accord (figures in mcm) (World Bank, 2018b)

Aquifer	Article 40 allocation				
	Estimated potential	Total Palestinian	Total Israeli	Unallocated	Total
Western	362.0	22.0	340.0	–	362.0
North Eastern	145.0	42.0	103.0	–	145.0
Eastern	172.0	54.0	40.0	–	94.0
Eastern (additional wells)	–	20.5	–	–	20.5
Eastern (unallocated)	–	–	–	57.5	57.5
Total	679.0	138.5	483.0	57.5	679.0
% of total		20%	71%	9%	100%

Article 40 specifies that in addition to the 138.5 mcm Palestinian allocation in the West Bank, an extra 3.1 mcm of freshwater from Mekorot for domestic use was to be made available to the Palestinian Authority for the West Bank during the interim period, and 5 mcm for Gaza. The extra supply for the West Bank from Mekorot was in addition to 27.9 mcm already being supplied by Mekorot at the time of the agreement. In addition, "future needs" of the Palestinians were estimated at 70–80 mcm (World Bank, 2018b).

Article 40 of the Oslo II Accord was based on three key assumptions, namely:

1. That Palestinian domestic water needs in the West Bank are 70–80 mcm per year in addition to the existing uses at the time of signing the agreement, 118 mcm per year;
2. That interim water development must be managed through a coordinated Palestinian-Israeli process and mechanism; and
3. That topics of "common interest" would be subject to further negotiations (World Bank, 2018a).

Additional resources were to be extracted from previously unused sources in the Eastern Basin of the Mountain Aquifer. Until their development, Israel was to begin supplying the Palestinians with approximately 25 mcm of water per year (World Bank, 2018b).

In Article 40, both sides agreed to coordinate the management of water and sewage resources and systems in the West Bank during the interim period, in accordance with the following principles:

"a. Maintaining existing quantities of utilization from the resources, taking into consideration the quantities of additional water for the Palestinians from the Eastern Aquifer and other agreed sources in the West Bank as detailed in this Article. b. Preventing the deterioration of water quality in water resources. c. Using the water resources in a manner which will ensure sustainable use in the future, in quantity and quality. d. Adjusting the utilization of the resources according to variable climatological and hydrological conditions. e. Taking all necessary measures to prevent any harm to water resources, including those utilized by the other side."

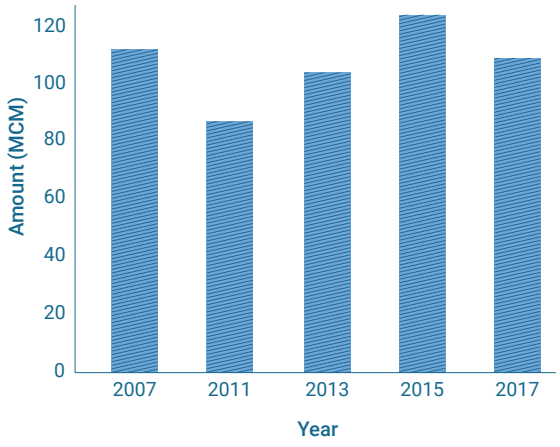

Figure 15
Quantity of water utilized from the Mountain Aquifer : Palestinian Water Authority database

According to the Palestinian Water Authority's database, the amount utilized from the Mountain Aquifer via the pumping of Palestinian wells and usage of spring water varies significantly by year (Figure 15).

The Israeli Civil Administration states that "the water quantities pumped by the Palestinians are not measured regularly, due to lack of piezometers in most of the Palestinian wells in the A and B Areas". The Israeli Hydraulic (water) Authority estimates that "Palestinians pump at least 150 million cubic metres per year" (GoI, 2019).

Water supply and domestic demand (current and projected)
Water supply and domestic demand are described in the table below, which is taken from World Bank analysis (World Bank, 2018a). As the table shows, there is a significant gap between domestic demand and supply, in both the West Bank and Gaza Strip. Non-revenue water levels are high: non-revenue water includes actual physical losses from the system, theft of water through illegal connections and water supplied to customers who are not billed (World Bank, 2018a).

Domestic and municipal use
Domestic water use includes many categories including bathing, cooking, drinking, washing clothes and other household functions. Municipal use of water includes use in both public and private buildings (e.g. schools and hotels), in public spaces (e.g. gardens and streets) and for fire protection. For domestic consumption "to achieve full health and hygiene benefits", the World Health Organization figure that is typically recommended as a "benchmark minimum" to achieve full health and hygiene benefits is 100 lcd, while the Palestinian Water Authority has set a target of 120–150 lcd for its population (World Bank, 2018a).

Gaza and the West Bank face significant and growing shortfalls in the water supply available for domestic use. Currently, only 4 per cent of the 180 mcm of water extracted annually from what used to be Gazans' main source of drinking water, the Coastal Aquifer, can be considered potable by World Health Organization standards (World Bank, 2018a).

As a result of damage to the Coastal Aquifer, access to safe drinking water in Gaza via the public water network fell from 98.3 per cent in 2000 to only 10.5 per cent in 2014, compared to almost 97 per cent in the West Bank. As a result, reliance on water tanks, containers and bottled water rose from 1.4 per cent to 89.6 per cent during the same period (UNCT, 2017). Aside from such source issues, while all localities in the Gaza Strip are connected to the water network and 93 per cent of Gaza's households are connected, only 30 per cent of households receive water daily (PCBS, 2015).

Daily per capita consumption of water has not varied greatly since 2012 (89.5 lcd) until 2017 (88.3 lcd), with a high of 91.3 lcd in 2013 and a low of 79.2 lcd in 2015. The World Bank quotes a figure of 89 lcd for the Gaza Strip in 2018.

Since 1995, the West Bank Palestinian population covered by the water network has increased by 50 per cent. However, about 10 per cent of Palestinian

Table 11: Water supply figures and supply gap, derived from (World Bank, 2018a), Palestinian Water Authority data

Water supply (mcm/year)				
	West Bank		Gaza Strip	
	2016	2030	2016	2030
Supply requirement (domestic demand) in 2030[a]	**152**	**209**	**100**	**135**
Groundwater/natural resources[b]	48	48	84	30
Desalination[c]	0	0	6	6
Mekorot purchase	69	69	10	20
Water harvesting	0	0	0	0
Subtotal	**117**	**117**	**100**	**56**
Non-revenue water	51			
Total supply (supply – non-revenue water)	66		62	
Supply gap	**80**	**92**	**38**	**79**

[a] Assume population of 1.9 million and 2.8 million in Gaza and 2.9 million and 4.4 million in West Bank and 100 lcd for 2016 and 2030, respectively.
[b] Actual in 2016 for West Bank and Gaza and sustainable yield in Gaza and no change in West Bank for 2030.
[c] Desalination—none in West Bank and in Gaza, from small desalination units

communities (49 out of 524) are still not connected to networks (PCBS, 2015). In these cases, the unconnected households often revert to the use of cisterns, local springs and tankers, frequently at a high cost for poor quality water, particularly in Area C (Thawaba, et al., 2017). About 25 per cent of households in the West Bank use water tankers and domestic wells to complement water supplied by networks (ARIJ, 2015).

The daily water consumption figures reported for the West Bank are lower overall than for Gaza and vary according to the source. Daily consumption levels have mostly trended upward since 2010 (73 lcd) until 2017 (88.3 lcd). However, the World Bank states that available water (water supplied minus water lost due to leakage, etc.) is only 62 lcd, while the most vulnerable communities in Area C, which are not connected to the water network, can have an average water consumption as low as 20 lcd (Thawaba, et al., 2017); (World Bank, 2018a): this is significantly below the levels recommended by the United Nations Special Rapporteur on the Human Right to Water and Sanitation (UN Special Rapporteur).

Since 2007, the quantities of water purchased in the West Bank from the Israeli water company, Mekorot, have been increasing. According to the Palestinian Water Authority, the amount purchased in 2007 was 45 mcm, while in 2012 it had reached

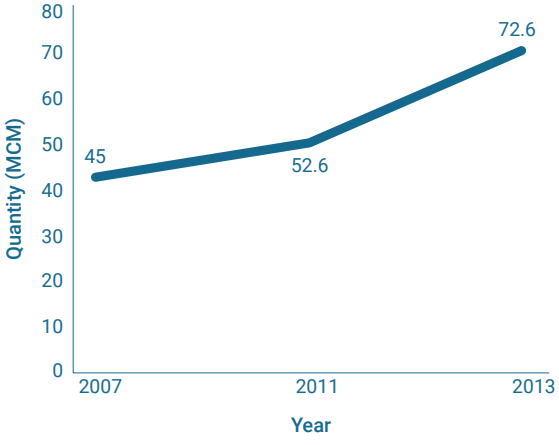

Figure 16
Quantity of water purchased (mcm/year) from Mekorot in West Bank Source: (PWA, 2017)

52.6 mcm and in 2017 was up to 72.6 mcm (PWA, 2017); (ARIJ, 2015). In Gaza, the amount of water purchased from Mekorot remained roughly stable from 2007 to 2014 (between 3.5 to 4.9 mcm) but increased to 10.6 mcm in 2017 (PWA, 2017); (ARIJ, 2015). In addition, since 2014 the quantity of water supplied in Gaza by over 150 small desalination plants employing the reverse osmosis method is between 4-6 mcm per year (PWA, 2015); (World Bank, 2018a), and some 2,000 small home-based desalination units add another 1 mcm/year (Hassouna & Sinclair, 2013).

Agricultural use (including livestock)

In 2005, nearly 53 per cent of the total agricultural production in the West Bank came from only 7 per cent of the land that was under irrigation, illustrating the importance of irrigation in Palestinian agriculture. On-farm irrigation is mainly by drip irrigation and in a few cases by sprinklers and flooding. The many wells operating are mainly used for irrigation and are usually owned by large landowners who sell water to smaller or landless farmers. Those used for domestic water supply are mainly controlled by municipalities, cooperatives or village councils. Springs are either jointly or communally owned. Some have no clear ownership rights, which subsequently lead to poor maintenance and management (FAO, 2008).

The systems that transport water from springs to farms consist of open earthen or lined canals and earthen buffer pools (usually plastic-lined). These tend to be in bad condition and are responsible for substantial losses of water through seepage and evaporation: losses are estimated at about 15 mcm per year. However, the water conveyance systems from wells to farms are closed, minimizing water losses (FAO, 2008).

Overall, the Palestinian Water Authority estimates that water quantity for agricultural and industrial use (including livestock) in 2017 was 162 mcm in Gaza (50 per cent of the total water use) and 65 mcm in the West Bank. The overall rate of water consumption for agricultural purposes appears to have been steady in the West Bank between 2010 and 2017 but increased by around 10 per cent over those years in the Gaza Strip. According to Israeli figures, Palestinian water use for agriculture is 107 mcm per year (GoI, 2019).

Wastewater and sewage treatment, industrial use

World Bank figures in the table 7 demonstrate that the capacity for treatment of wastewater falls significantly below the amount of wastewater produced, and that this "treatment gap" is likely to reach 72 mcm by 2030 unless additional capacity is developed.

Table 12: Water use statistics from various sources and years compared

Use	FAO Aquastat 2008 (2005 figures)		ARIJ 2015 et al. (mcm) (2013–2014 figures)			World Bank 2018a (mcm) (2013–2014 figures)		
	Occupied Palestinian territory overall		Gaza Strip	West Bank	Totals	Gaza Strip	West Bank	Totals
Domestic/ municipal	200	48%	103.3	101	204.3	93.2	100.9	194.1
Agriculture and livestock	189	45%	95.3	62	157.3	85.7	62.2	147.9
Industrial use	29	7%	(incl. in domestic/municipal)					
Total water withdrawal	418	100%	198.6	163	361.6	178.9	163.1	342

Table 13: Waste water data: *Securing Water for Development in the West Bank and Gaza(World Bank, 2018)*

Wastewater (mcm/year)				
	West Bank		Gaza Strip	
	2016	2030	2016	2030
Domestic demand in 2030		**167**		**106**
Existing plants	9.5		60	
Treated in Israel	21.4		0	
On-site treatment	64.6		0	
Subtotal	**95.5**		**80**	
Treatment gap		72		

Data taken from World Bank, Securing Water for Development in West Bank and Gaza (World Bank, 2018a).
The source of the data for 2016 is the PWA (PWA water table 2016). Assumption for 2030 if final negotiation with Israel is not pursued. Assume population of 1.9 million and 2.8 million in Gaza and 2.9 million and 4.4 million in West Bank and 100 lcd for 2016 and 2030, respectively. Volume of wastewater is estimated at 80 percent of water demand.

Only two thirds of the generated wastewater collected in sewage networks is discharged into a wastewater treatment facility (PWA, 2012). According to World Bank data collected only with reference to the West Bank, "only 30 per cent (or 21 mcm) of the 69 mcm of wastewater is collected and only 9.5 mcm is treated. The result is that 25 mcm of untreated sewage is discharged into the environment each year from 350 locations. Some 21.4 mcm of this flow into Israel which charges the Palestinian Authority for necessary treatment" (World Bank, 2018a). According to the Israeli Civil Administration, 40 mcm of the annual total 69 mcm Palestinian wastewater is disposed of in streams or absorption pits (GoI, 2019). The Palestinian Authority reports that Israeli settlements discharge 40 mcm per year of untreated wastewater into wadis (SP, 2019).

Some wastewater from Palestinian towns and villages is treated at Israeli treatment plants: Bethlehem and Beit Jala at the Soreq plant, Tulkarem and Nablus at the Yad Hannah plant, and Qalqiliya at the Drom Sharon Mizrachi plant. Wastewater from some Israeli settlements is treated at the El-Bira wastewater treatment plant in the occupied Palestinian territory (Cohen, 2016). According to Israeli figures, 22 mcm of Palestinian wastewater is treated in plants inside Israel (GoI, 2019). Israel charges the Palestinian Authority for wastewater treatment, and the Palestinian Authority is accumulating arrears for such treatment, because costs are not recovered by the Palestinian Authority at the service provider level (World Bank, 2018a).

The Palestinian Authority reports that in Gaza, the annual wastewater collected by sewage networks is approximately 41.3 mcm per year, of which 37.6 mcm per year is partially treated before being discharged into the Mediterranean Sea. The wastewater treatment plants are North Gaza – Beit Lahia wastewater treatment plant, Gaza Central wastewater treatment plant, Khan Younis wastewater treatment plant, Rafah wastewater treatment plant and Wadi Gaza wastewater treatment plant (PWA, 2012). For a sustained period, the wastewater treatment plants in Gaza have been overloaded. New infrastructure has been constructed, as viewed by the UNEP team during its mission to Gaza in February 2019; this infrastructure should lead to some improvement in wastewater management. This construction has, however, been beset by delays, which have led

inter alia to a substantial increase in project costs (World Bank, 2019).

Finally, in all Palestinian governorates, sewage overflows are frequent or occasional for 18 per cent of the population using improved sanitation. These overflows occur more often in the northern governorates of the West Bank. Tubas, Salfeet and North Gaza had the highest percentage of the population experiencing an overflow at least once in a month in 2016 (World Bank, 2018a).

7.3 Pressures and impacts

The following paragraphs attempt to enumerate and briefly describe pressures on water resources:

- **Expanding population**
  The population is growing at an average annual rate of 2.7 per cent. The gap in domestic water supply by 2030 is projected to be approximately 92 mcm per year for the West Bank and 79 mcm per year for Gaza, unless supply and service options are expanded (World Bank, 2018a).
- **Over-abstraction leading to aquifer damage in Gaza**
  Groundwater is being abstracted from the coastal aquifer at almost three times the sustainable abstraction rate, thereby causing seawater intrusion, which along with sewage pollution make the resource largely non-potable. According to the Palestinian Authority, wells have also been dug in Israel which limit the flow of water into the aquifer (SP, 2019).
- **Water Losses**
  The amount of water lost as it moves through delivery systems is high. Non-revenue water – lost water which cannot be charged for – ranges, on average, from 29 per cent at the service providers' level and 15 per cent (10 mcm/year) at the bulk water supply level in the West Bank to 40 per cent in Gaza, with some municipalities experiencing 53 per cent of their water lost. This equates to 267 litres of lost water per day for each connection in the West Bank and 600 litres per day per connection in Gaza. In total, this translates into 82 mcm of lost water per year (World Bank, 2018a).
- **Electricity**
  In Gaza, the lack of sufficient and reliable electricity supply to the water and wastewater sector has, in the recent past, proved an obstacle to achieving efficient and adequate water service provision (World Bank, 2018a). The supply of electricity improved in October 2018, and this had a positive impact on the treatment of wastewater (OCHA, 2019).
- **Infrastructure**
  Recurring conflict with Israel has severely damaged Gaza's infrastructure for water, sanitation and hygiene; restrictions on access and the movement of goods have hampered repairs to the degraded, mostly old and poorly maintained infrastructure. Israel has for years restricted the import of 'dual-use' items, including 70 per cent of the technical equipment, for example, pumps and water purification chemicals, which is needed to maintain water and sanitation (Efron, Fischbach, Blum, Karimov, & Moore, 2018).
- **Palestinian Water Authority debt**
  The Palestinian Water Authority is unable to pay Mekorot for the bulk water it purchases and is accumulating debt to Israel. In the West Bank, every bulk water purchase from Mekorot puts the Palestinian Water Authority in further arrears to Israel because of the lack of cost recovery at the service-provider level. The 2014 Water Law was designed to clarify accountabilities and establish autonomous utilities, leading to enhanced cost recovery; implementation, however, has been slow due to an incomplete legal structure, lack of financing, and lack of clarity of rules and responsibilities at the local level (World Bank, 2018a). Israel deducts an amount to cover bulk water purchases and wastewater treatment from the taxes (clearance revenues) it collects on behalf of the Palestinian Authority. According to the World Bank, the total arrears in 2017 stood at about US$335 million. In 2016, the Israeli Minister of Finance deducted US$94 million from clearance revenues due to the Palestinian Authority for unpaid Mekorot water bills (net lending) and for wastewater treatment. Imports from Mekorot to Gaza are increasing (World Bank, 2018a).
- **Poor and divided water governance**
  The division between the Palestinian Authority and the *de facto* authorities in Gaza is another source of pressure on the water service. The Palestinian Water Authority has a branch in Gaza, but its effectiveness has been constrained by a parallel Palestinian Water Authority set up in Gaza by the *de*

facto Hamas administration (World Bank, 2018a). The division has contributed *inter alia* to interruptions in the power supply and to changes of water sector personnel.

- **Limited revenue collection**
  Tariffs in both West Bank and Gaza are low. In Gaza, tariffs only cover two thirds of costs. Service providers collect only 37 cents per dollar of sales, with the result that the average provider covers less than 24 per cent of its costs. In 2014, on average, Gaza service providers incurred a shortfall of US$0.7 for every cubic metre supplied. In the West Bank, the average tariff barely covers operating costs, but service providers collect only 68 per cent of bills issued and only 76 cents per dollar of costs (Efron, Fischbach, Blum, Karimov, & Moore, 2018).
- **Stresses imposed by unregulated industries**
  Industrial wastewater, including from quarries, tanneries and olive mills, is dumped into municipal sewers. This has a devastating effect on the environment and wastewater treatment plants, which are not designed to deal with such waste (World Bank, 2019).
- **Climate Change**
  Increasing temperatures and extreme weather events are likely to contribute to diminishing water availability (see Chapter 8).

Impacts on people and the environment

The major impacts resulting from the above-described pressures and the status and use of water resources can be categorized by examining: a) the impacts on groundwater and surface water resources; b) human and health-related impacts; and c) impacts on the physical environment. The impacts are more acute at present in Gaza than in the West Bank.

Surface water resources: quantity and quality

In the mid-20th century, the annual flow of the Jordan River was estimated at 1,400 mcm per year (ARIJ, 2007). Since then, the Jordan has diminished due upstream infrastructure, including Al-Wehda Dam on the Yarmouk and the Israeli diversion of some 500 mcm per year of the river's water through the National Water Carrier to the Negev. Over the last 50 years, approximately 96 per cent of the Jordan's natural flow has been diverted. The wetland ecosystem of the Lower Jordan has collapsed and over half of its biodiversity has been lost (Swagerty, 2014). Israel uses about 64 per cent of the Jordan River's total water (ARIJ, 2007). Israel's National Water Carrier, which was built in 1964, diverts water from the Sea of Galilee/Lake Kinneret "and other water sources in the north, to the arid areas in the south" of Israel, 130 km away (Mekorot , 2019).

Surface water resources in the West Bank suffer major impacts from water extraction and pollution, as well as agricultural land runoff. For example, the quality of water in the lower Jordan River is much poorer than in the upper Jordan River due to input from saline springs and contamination from irrigation return flows and raw sewage (ARIJ, 2015). Palestinians have not had any access to Jordan River waters since 1967 because the river valley is under Israeli military control.

According to World Bank figures, only 30 per cent of the 69 mcm West Bank wastewater is collected and only 9.5 mcm is treated, with the result that 25 mcm of untreated sewage is discharged into the environment. Some 21.4 mcm flows into Israel (World Bank, 2018a).

Major streams in the West Bank are highly polluted and are even referred to as "wastewater channels" in some literature. The lack of wastewater treatment and the parallel expansion of water supply works have led to increasingly severe environmental pollution. Hebron Stream (Wadi Al Samen), which flows towards the Beer Sheva Valley and contributes to the Besor Stream, has become a polluted wastewater channel. Nearby communities suffer badly from polluted water, odour, flies and mosquitoes. Nablus Stream (Wadi Al Zomar), which flows in a westward direction, has become a wastewater channel for Nablus, while in the downstream section it also serves as a wastewater channel for Tulkarem. Flows containing wastewater from both sources debouch into the Alexander Stream to the west of the Green Line (GoI, 2019). The environmental hazards affect both Israelis and Palestinians (IWA, 2009). Other major wastewater streams include the Wadi Suriq near Ramallah and the Wadi Al-Nar near Bethlehem (ARIJ, 2015). Settlements also contribute to environmental degradation in the West Bank via the release of untreated or partially treated wastewater. According to the Israeli Civil Administration, the Israeli settler population in the West Bank (not including East Jerusalem) produces a total of 21 mcm of wastewater per year, of which 2.5 mcm "are not treated (disposed to streams or to absorption pits)" (Israeli Civil Administration,

April 2019). The following regions are severely affected by the release of wastewater from Israeli settlements:

- The Wadi al-Nar area is affected by 4,500 m3 of wastewater per day from the settlements near Jerusalem (ARIJ, 2015);
- The north-eastern region of Hebron is affected by wastewater from settlement wineries;
- The Wadi Qana area is affected by wastewater from the Ariel settlements and other settlements in the area;
- Wadi Qalqilya, Wadi Fukeen, Jenin and Wadi al-Samn in Hebron, and Zawata in Nablus are all affected by settlement wastewater; and
- Settlements like Barqan and others surrounding Salfit have impacts on Bruqin and villages nearby Salfit (Shreim, 2012).

Many streams have become wastewater channels for local towns and villages, from which the untreated wastewater infiltrates into the groundwater of the Mountain Aquifer, affecting its quality. Most of the untreated wastewater is drained directly into either dry valleys or seasonal springs. "The north-western strip of the Mountain Aquifer's recharge area, around the cities of Tul Karem and Qalqiliya, is particularly vulnerable to pollution." (Tagar, Keinan, & Bromberg, 2004).

While there are no surface waters as such in Gaza, other than the much-diminished Wadi Gaza, the flow of largely untreated wastewater into Wadi Gaza, via the Wadi, and directly from other outfalls along the 40 km coastline into the Mediterranean Sea, is worth highlighting. The amount of partially treated and untreated wastewater flowing into the Mediterranean has been increasing in recent years: from 90,000 cm per day in 2012 to 100,000 cm per day in 2016 and 110,000 cm per day in 2018. In 2017, the United Nations Country Team estimated that this amount would reach 120,000 cm per day by 2020, with significant environmental consequences not only for Gaza (UNCT, 2017).

Wadi Al-Nar near Bethlehem, February 2019 (photo credit: RGWitt). A plan has been developed for treatment of the wastewater that flows into this stream.

Sewage outflows from Gaza have transboundary effects (also covered in Chapter 6), including (i) impact on marine and coastal biodiversity; (ii) impact on broader Mediterranean ecological and human well-being; (iii) impact on fish population; and (iv) impact on desalination. The discharge of sewage every day into the Mediterranean Sea creates public health issues in neighbouring Israel and Egypt, and partially treated wastewater also infiltrates into the groundwater in North Gaza (Efron, Fischbach, Blum, Karimov, & Moore, 2018). Although pollution levels have reduced from a biological oxygen demand average level of 265 mg/L in 2017 to an average of 185.6 mg/L during the first five months of 2019, the level is far above the international standard of 60 mg/L (OCHA, 2019).

Groundwater resources: quantity and quality

Gaza: Decades of excessive pumping of the Coastal Aquifer have led to the infiltration of seawater from the Mediterranean and brine from deeper layers. While the aquifer's annual safe yield (based on its recharge rate) is 55 to 60 mcm, estimates of the amount being pumped range from 160 to 200 mcm per year, or three to four times the recharge rate (ARIJ, 2015). Salinity levels are now well beyond World Health Organization guidelines (WHO, 2011) for safe drinking water.

The intensive use of agricultural pesticides, along with the inflow of sewage into the aquifer, has also resulted in high concentrations of nitrate in groundwater. The World Health Organization guidelines recommends a nitrate concentration of less than 50 mg/L, but the actual concentration of nitrate varies from 50 mg/L in non-residential areas (southeast of Rafah) to more than 300 mg/L in parts of Gaza that are still served by cesspits, such as Khan Younis (ARIJ, 2015) (see Figure 17).

Box 11: Untreated wastewater flows into West Bank watercourses, and from the West Bank to Israel

In the West Bank, untreated wastewater and illegal solid waste dump sites contaminate groundwater. According to a 2016 evaluation by the Israel Nature and Parks Authority, issued in partnership with the Israel Ministry of Environmental Protection and the Civil Administration, three quarters of the wastewater released by Palestinian and Israeli residents of the West Bank "does not undergo basic treatment". According to this analysis, untreated effluents from Palestinian towns and villages "are discharged to rivers, some of which are post-primary treatment and others are not treated at all" (Cohen, 2016).

Another report by the Israeli State Comptroller notes that in contrast to the extensive activity evident in the field of water supply installations, there has been only limited progress made with respect to Palestinian wastewater treatment plants and proper reuse of the effluents for agriculture. This essential activity has been stalled for several years. Regions seriously affected by the discharge of wastewater include Al-Nar/Kishon, Alexander-Nablus and Hebron streams (Shapira, 2017).

Israeli official documents also note that settlements discharge untreated wastewater into the environment. The Israel Nature and Parks Authority Evaluation states that with respect to Israeli settlements, "immediate solutions are needed to remove wastewater from the Kidron River and treat wastewater from Qiryat Arba, Ofra and Kedumim. The effluents flowing in the Kidron Valley, in the section between East Jerusalem and the Horkanya Valley, are characterized by high flow rates and high organic material." While "there has been an improvement in the development of the collection infrastructure and treatment of wastewater in Israeli settlements… there are still settlements where wastewater is not collected or treated at all". This "has many environmental implications, due to hydrological sensitivity, as the main recharge area of the Mountain Aquifer overlaps the contaminated rivers" (Cohen, 2016).

According to an unpublished note from Israeli Civil Administration, in the Hebron stream, there is a flow of Palestinian wastewater from Hebron, composed of raw sewage and industrial waste from the Hebron Industrial Area, which constitutes the main source of pollution in the stream. Similarly, the Kidron/al-Nar Stream has been consistently polluted for years by wastewater which flows from the East Jerusalem, Bayt Sahour and Bethlehem areas. According to Israeli figures, in 2015 approximately 90 mcm of wastewater was produced per year, of which only 30.6 mcm of wastewater underwent treatment, while the rest was discharged into the environment (either to cesspits or streams). Israel also reports that discharge of waste from olive presses (pomace) pollutes streams (GoI, 2019).

The three main effects identified in the report of Israeli State Comptroller with regards to pollution of groundwater and streams are: (a) decrease of available water for the population living in the area; (b) harm to public health and quality of life due to sanitation hazards and environmental nuisance; and (c) damage to ecological systems (Shapira, 2017). The geopolitical situation, the protracted political conflict between Israel and the Palestinians, the division of control over the territory and the perception of the temporary nature of the situation are cited as impediments to dealing with environmental hazards in a thorough and cooperative manner.

The Israeli State Comptroller report also highlights the absence of Israeli government policies and the deficiencies in approval, coordination and initiation of projects funded by international bodies as major barriers towards resolving the transboundary water pollution issues. "The Government of Israel has not yet formulated a policy for cross-border environmental management in general and for the management of water pollution in particular, and has not decided on any single governmental entity to be charged with this issue and manage it with the responsible bodies." (Shapira, 2017).

The Government of Israel reports that in 2019, it invested US$278,334 (NIS 1 million) in collecting waste from olive presses, and has acted to address chromium contamination in the Hebron stream from tanneries in Hebron (GoI, 2019).

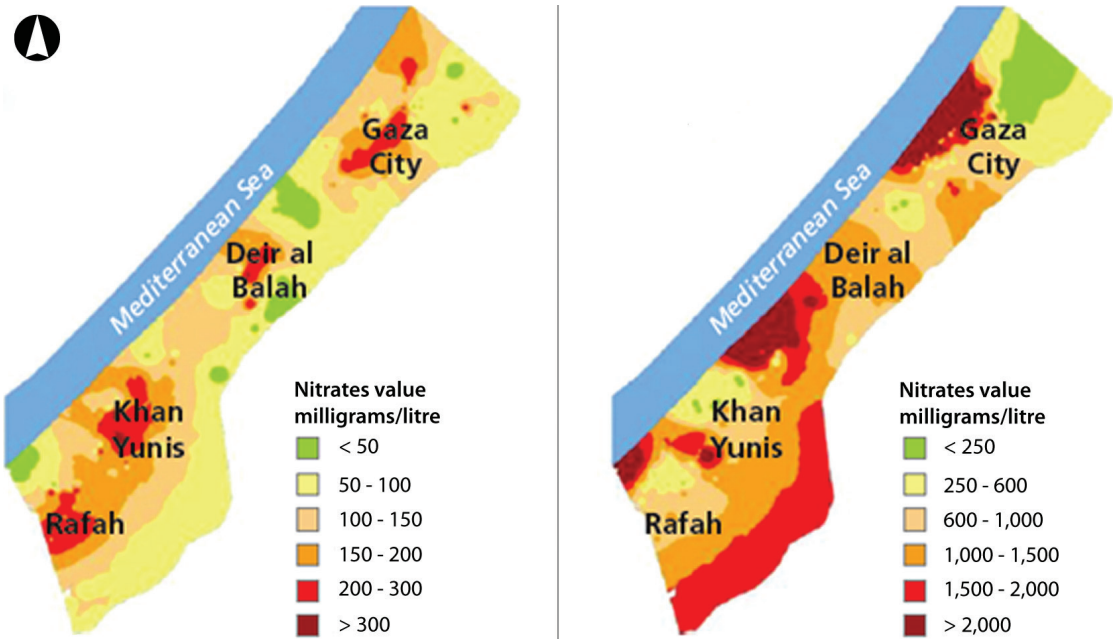

Figure 17
Contour map of Gaza Coastal Aquifer Nitrate and Chloride Contamination (Efron, Fischbach, Blum, Karimov, & Moore, 2018)

Only small parts of the aquifer in Northern Gaza and west of Khan Younis have waters with a chloride concentration of less than 250 mg/L. Chloride concentrations in the aquifer vary between 500 and 1,500 mg/L, while along the coastline the concentration of chloride exceeds 2,000 mg/L (ARIJ, 2015); (EPME/KAS, 2017); (PWA, 2015). The World Health Organization approved guidelines is up to 250 mg/L. It is estimated that 97 per cent of the aquifer's groundwater is unfit for human consumption (Efron, Fischbach, Blum, Karimov, & Moore, 2018).

The water quality problem in Gaza has been exacerbated by the drilling of private wells, which the Palestinian Water Authority has been unable to regulate, in part because of the political division and establishment of *de facto* Hamas authorities. There are some 260 municipal wells that typically have chloride and nitrate levels above standards set by the World Health Organization. With normal well water unfit for human consumption, 97 per cent of the population rely on informal and unregulated private water tankers and small-scale desalination plants for drinking water. Water provided through networked systems by formal providers is used for other domestic purposes (World Bank, 2018a).

The recharge of the Coastal Aquifer has also been diminished by construction. The proportion of built-up area in Gaza increased from 8.25 per cent in 1982 to 25.23 per cent in 2010, while the sand dune area shrank from 31.46 per cent to 8.64 per cent during the same period. Runoff doubled during this period from 6.9 mcm to 13.7 mcm, while groundwater recharge decreased from 24.4 mcm in 1982 to 18.1 mcm in 2010 (Mushtaha, Van Camp, & Walraevens, 2019).

Demand for already scarce potable water in Gaza will continue to rise. The United Nations Country Team has already warned that by 2020, Gaza's coastal aquifer may be irreversibly damaged (UNCT, 2017). With the supply of water too low to meet demand, the living and health conditions in Gaza can only further deteriorate, exposing the population to water-borne illnesses and other threats (UNCT, 2017).

West Bank: Although groundwater quality in the West Bank is generally acceptable, localized high concentrations of chlorides and nitrates have been identified (World Bank, 2018a). Pollution from mostly Palestinian sources constitutes an increasing concern, and in the Tulkarem and Qaliqilya areas, some 40 wells are reported to have

increased pollution levels either due to sewage or poor agricultural practices (EPME/KAS, 2017). There are also gaps in the data concerning groundwater quality: the Palestinian Water Authority's annual reports only have data for groundwater quality in the West Bank for selected wells in the Jordan Valley, Qalqiliya and Tulkarem. These tests show that most wells in the Jordan Valley have a high concentration of chloride exceeding the acceptable guideline of the World Health Organization, whilst showing low nitrate concentration. In Tulkarem and Qalqiliya, the nitrate concentration exceeds the World Health Organization limit of 50 mg/L in some wells, while the chloride concentration in these wells is within the acceptable limit (PWA, 2013).

Human health

Contamination of the Coastal Aquifer and the broader water and sanitation crisis has contributed to a situation in which 26 per cent of all diseases observed in Gaza are water-related. The most common diseases include acute bloody diarrhoea, viral hepatitis, liver and kidney diseases, methemoglobinemia (blue baby syndrome) and anaemia (UNICEF, 2011).

The incidence of cancer in Gaza is also high, with concentrations occurring next to agricultural areas where water supplies are highly contaminated with traces of phytosanitary by-products (Hassouna & Sinclair, 2013). Inadequate water quantity and quality, arising from both biological by-products and chemical contamination, are associated with different diseases and transmission mechanisms such as waterborne transmission of gastrointestinal disease through the faecal-oral route due to poor drinking water quality (contaminated water) or inadequate water quantity, and associated poor hygiene (contaminated food, fingers and utensils). Other 'water-washed' skin and eye diseases are also associated with inadequate water quantity (Efron, Fischbach, Blum, Karimov, & Moore, 2018).

In Gaza, serious health impacts are caused by the following (from Efron, Fischbach, Blum, Karimov, & Moore, 2018):

- **Chemical contamination** (from chlorides, nitrites and nitrates) stems from two main sources, untreated or undertreated sewage and runoff from fertilizer in agricultural areas. Because the water used by Gaza residents is largely untreated, chemical contaminants such as chloride (Cl-), nitrite (NO2), and nitrate (NO3) are often present in drinking water. A 2015 study found that only 12.4 per cent of wells in Gaza met World Health Organization standards for nitrate concentrations, and only 19.3 per cent of wells met chloride concentrations standards. These contaminants, along with nitrites, present particular risks to children, infants and pregnant women, who are more susceptible to long-term harm from exposure. A study published in 2013 showed that 59 per cent of wells in Gaza exceeded the World Health Organization maximum for nitrite concentration (Abbas, et al., 2013).
- **Biological contamination** manifests itself through waterborne diseases such as cholera. Gaza being one of the most densely populated areas in the world, is particularly vulnerable to an outbreak of this type. Due to its lack of wastewater treatment and inadequate quantities of water for personal hygiene, the risk of an outbreak of a waterborne or other intestinal disease is high. In Gaza, the most acute risks are linked to faecal contamination – which can be a source of pathogenic bacteria (cholera, salmonella or shigella) – viruses (enteroviruses, including polio) and parasites (such as Giardia). Water-associated diseases account for approximately 26 per cent of disease in Gaza and are the primary cause of child morbidity: diarrhea – preventable and easily treated – was the cause of 12 per cent of infant and young child deaths in Gaza in 2009 (UNICEF, 2011).
- **Bacterial pathogens** can cause symptoms such as abdominal cramping, bloody diarrhoea, vomiting and fever. The risk of bacterial contamination in drinking water increases with each additional transfer point before the water reaches the user. For individuals in Gaza who are dependent on water tanks to deliver large quantities of drinking water, this means higher exposure rates to numerous coliform strains, faecal and others.
- Viral pathogens may result in the transmission of enteroviruses such as polio and viral meningitis in populations with poor personal hygiene, due to untreated and contaminated water. While polio has largely been eradicated in Gaza, viral meningitis is still one of the most common infectious diseases seen in children in Gaza. Outbreaks are common and have

occurred in 1997, 2004, and 2013. Infants and children were disproportionately affected each time. Rotavirus is another important viral disease affecting Gaza, mostly in children under five years of age.

- **Giardia and other intestinal parasites** are a leading cause of diarrhoea in children, which is in turn associated with higher rates of malnutrition and possible developmental impairments. In one study, between 26.7 and 28 per cent of stool samples from 150 kindergarten children in Gaza were found to have such parasites, and 59.2 per cent of examined children were found to suffer from a parasitic infection. Rates of intestinal parasites among children living in Gaza may reach their highest levels in agricultural areas and near open sewage ponds.
- **Limited water quantity for personal hygiene** (including handwashing) leads to a number of risks and is also a direct source of disease in Gaza. In September 2017, the Palestinian Ministry of Health published a report on communicable diseases in Gaza that identified several diseases transmitted through poor personal hygiene and weakened infrastructure: acute hepatitis A, typhoid fever and acute diarrhoea. Waterborne diseases and those associated with insufficient hygiene, particularly those which cause diarrhoea, are currently a primary cause of illness in children.

Domestic sector

The scarcity of freshwater as a commodity has led to high costs to access sufficient quantities for domestic use, both in Gaza and the West Bank. Some residents of Gaza spend as much as a third of their income on water, and 83 per cent of households report relying mainly on private vendors (Efron, Fischbach, Blum, Karimov, & Moore, 2018). Palestinian Water Authority statistics show that a typical West Bank Palestinian family spends on average 8 per cent of its monthly expenditure on purchasing water, as compared to the worldwide average of 3.5 per cent. This figure jumps as high as 50 per cent for those Palestinian families forced to rely on tanked water (Thawaba, et al., 2017).

Roughly 10 per cent of Palestinian communities in the West Bank are not yet connected to the water network and are completely dependent upon water tankers transporting water from nearby networked sources, rainwater collection methods, bottled water, untreated spring water and agricultural wells (PCBS, 2015). Those who rely on water from water tankers pay up to 400 per cent more per litre for clean water than communities connected to the network, while suffering from poor quality, particularly in Area C (Thawaba, et al., 2017).

Economy

There are other economic impacts to also be considered, including the Palestinian Water Authority's accumulating debt to Mekorot for water purchases, which were estimated at about US$335 million in 2017 (World Bank, 2018a). To meet the growing demand for water, it is important to promote investment in water infrastructure. The World Bank has proposed establishing a Palestinian national committee to settle water-related debts and adopt an incentive-based mechanism for water infrastructure investments. This committee would agree with municipalities and service providers on their debt balances and payment schedules; this would "be linked with a performance-based incentive programme for investment support". "[Municipalities that] improve performance (that is, increase collection, reduce costs, implement tariff structure, reduce non-revenue water, and so on), would be illegible for incentive to finance their activities. The same committee could follow up on improving the governmental fiscal transfer policy to be adopted in the long term." (World Bank, 2018a).

7.4 Responses

Existing institutional framework for the water sector

Within the Palestinian Authority, there are six separate bodies that have major responsibilities in the water and sanitation sector:

1. The Palestinian Water Authority, which is effectively the ministry for water issues;
2. The Water Sector Regulatory Council, set up under the 2014 Water Law, is mandated to regulate the sector, approve tariffs, issue licenses, regulate service providers and protect consumers;
3. The Ministry of Local Government supports, monitors and regulates local government units, which are responsible for the provision of water supply and sanitation services;
4. The Ministry of Finance and Planning;

5. The Ministry of Agriculture is responsible for agricultural wells; and
6. The Environment Quality Authority is responsible for monitoring water quality.

The Palestinian Water Authority, the country's central body for the water and wastewater sector, was established by Presidential Decree in 1995. The main roles of the Palestinian Water Authority are to act as the main regulatory body for water resources management, development and infrastructure planning, as well as executing water policy (ARIJ, 2015). When established, the Palestinian Water Authority was placed directly under the Palestinian President. The Palestinian Water Authority has an independent budget and legal status (ARIJ, 2015). Aside from the West Bank, the Palestinian Water Authority has a branch in Gaza, but its effectiveness has been constrained by the establishment of a parallel water authority set up by the *de facto* administration (World Bank, 2018b).

In terms of implementing entities, the Coastal Municipalities Water Utility in Gaza and the West Bank Water Department operate and maintain the regional bulk water distribution systems. The West Bank Water Department was created in 1966 during the Jordanian administration and came under Israeli control after 1967. In 1996, the control of the West Bank Water Department was transferred from the Israeli Civil Administration to the Palestinian National Authority, according to Article 40 of the Oslo II Accord. The Coastal Municipalities Water Utility was formed in 2005 to unify a fragmented system of municipal and local water utilities in the Gaza Strip. The provision of water for the 25 municipalities is undertaken by the regional Coastal Municipalities Water Utility (ARIJ, 2015).

In the West Bank, the delivery of water services including water extraction is carried out by the Palestinian Water Authority and the West Bank Water Department. The sources of delivered water are Palestinian Water Authority and West Bank Water Department wells, municipal wells and springs, privately-owned wells and water purchased from Mekorot. There are two regional utilities in the West Bank: the Jerusalem Water Undertaking providing water services to East Jerusalem, much of Ramallah and the Al Bireh governorate, and the Water Supply and Sanitation Authority for the Bethlehem area (ARIJ, 2015).

The remaining West Bank and all Gaza households are serviced by providers under the aegis of the Ministry of Local Government. The larger towns have municipal water departments, 76 in the

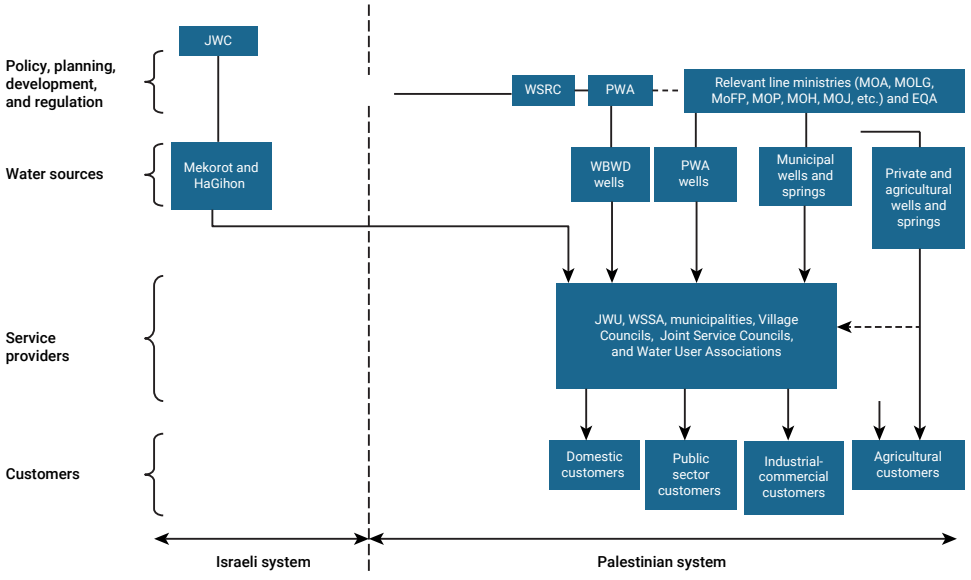

Figure 18
Institutional arrangements for water delivery in the West Bank (World Bank, 2018b) – note that since the publication of this diagram by the World Bank, the Ministry of Planning has been incorporated into the Ministry of Finance and Planning.

West Bank and 25 in Gaza, providing water and/or sanitation services. In the West Bank, many municipalities and villages have joined together to form Joint Service Councils (13 to date), which provide water and/or wastewater services. Some 162 village councils also deliver water and wastewater services (World Bank, 2018b). These regional, municipal and local water utilities operate and maintain the water network infrastructure and set and collect payments for water services (ARIJ, 2015). The Palestinian water sector in the West Bank is typified by a fragmented and heterogeneous make-up. The bulk water supply of these often low-capacity operators is dependent on Mekorot, a single high-capacity Israeli water company (Thawaba, et al., 2017).

In Gaza, domestic water production and supply mainly comes from municipal wells, in addition to water purchased from Mekorot, and the United Nations Relief and Works Agency wells that supply the refugee camps (Thawaba, et al., 2017).

Existing legal framework for the water sector

The Palestinian Water Authority adopted a Palestinian National Water Policy in 1995 to address key issues in water management and planning, such as legislation and the structure and tasks of entities in the water sector. In 1998, the first Water Resources Management Strategy was published based on the principles of the National Water Policy. A National Water Plan was prepared by the Palestinian Water Authority in 2000, which was meant to set directions until 2020. The Water Law No. 3 of 2002 was focused on further developing and better managing water resources, and an Integrated Water Resources Management Plan was developed for the West Bank in 2003 (ARIJ 2015).

In the last decade, a number of additional policy measures have been promulgated and reforms proposed. In 2014, a new Strategic Water Resources and Transmission Plan and the Water Sector Policy and Strategy were issued, describing the sector's goals and needs, and dealing with multiple water-related aspects such as water quantities, groundwater, surface water, desalination, rainwater harvesting and wastewater reuse, wherein the latter was considered one of the main water resources for agriculture (ARIJ 2015).

Following the new 2014 Water Plan and Strategy, a new Water Law (decree 14) was endorsed, establishing a new organizational structure for this sector. This law is aimed at developing and managing water resources, increasing capacity, improving quality, protecting water from pollution and depletion, and improving the level of water services. According to the new law, the process of policy and strategy formulation is to be separated from the regulatory functions. It made the Palestinian Water Authority responsible for managing and regulating water resources including abstraction quotas and the allocation of resources for different sectors, preparing policies, strategies and plans, and ensuring their implementation (ARIJ, 2015).

While the 2014 Water Law was meant to clarify accountabilities and set up autonomous utilities, implementation has been slow due to an incomplete legal structure, lack of financing, and lack of clarity of rules and responsibilities at the local level (World Bank, 2018a). One of the major reforms for the water sector under the 2014 Water Law was the establishment of a national water company, along business lines and similar to the Israeli company Mekorot, that would serve as the bulk provider and offer consolidated services for both the West Bank and Gaza.

There have been several issues implementing this Water Law. For example, the Palestinian Water Authority drafted the action plan for setting up the national water company, another key reform in the water sector, via a phased transformation of the West Bank Water Department into the new company. To date, no decision has been made to implement it, however. These reforms are meant to be completed by 2022; however, institutional strengthening and rationalization remain in their early stages. For now, most services continue to be provided by various service providers under the aegis of the Ministry of Local Government (World Bank, 2018a).

The Joint Water Committee and Israeli-Palestinian cooperation

When the Interim Agreement was signed in September 1995 between Israel and the Palestine Liberation Organization, the main mechanism to implement its Article 40 was an Israeli-Palestinian Joint Water Committee. The Joint Water Committee was originally meant as a temporary body to last only five years, and was tasked with developing and modernizing the water infrastructure in the West Bank, allowing better

water access to Palestinian towns and villages, maintaining existing infrastructure and approving new projects (Selby, 2013).

The Joint Water Committee met on a regular basis from 1995 until 2008 but ceased to function between 2010 and 2017. A new deal to revive the Joint Water Committee was signed between the two sides in January 2017, according to which both parties would be able to promote some water projects without the need for a Joint Water Committee approval by consensus. This ensured that the Palestinian Authority would have limited autonomy to handle water issues in Areas A and B, allowing a total of nearly 100 suspended water and sewage projects to progress. (The Joint Water Committee is also covered in Chapter 12 of this report.) The Joint Water Committee has not provided a sufficiently effective mechanism to facilitate the exchange of data on water withdrawals, or to secure agreements on the types and locations of water and wastewater infrastructure. Significant discrepancies remain between Palestinian and Israeli water data.

It is relevant to note in this context that the Palestinian Water Authority is advancing a solution for wastewater in Wadi al Nar/Kidron, in cooperation with the Jerusalem municipality. A pipeline and pre-treatment facilities are planned to run along the route of the stream, which will be laid by the Palestinian Water Authority in Areas A and B. The Israel Water Authority will implement the works in Area C (GoI, 2019).

International Cooperation

The Palestinian Authority is heavily dependent on financing from the international community to develop new water-related and sanitation infrastructure and enhance existing systems. Water resource projects and new systems tend to be coordinated by the Palestinian Water Authority together with international donors. These donors have played a pivotal role, providing the bulk of Palestinian Water Authority running costs as well as project finance, and shaping institutional priorities (Selby, 2013).

The process of obtaining donor funding begins with the periodic development of a three-year plan that outlines the sector's development needs. The plan is submitted to various donors. For projects in the West Bank, donors request approval from the Israeli-Palestinian Joint Water Committee and Israeli Civil Administration if the project or part of it is to be implemented in Area C. Failure to obtain project approval leads donors to postpone, cancel or reallocate the fund to other sectors. The Palestinian Water Authority's water sector strategy for 2014–2032 estimates that around US$7 billion would be required to cover investment needs. Most sources of funding are yet to be identified (Fanack Water, 2015).

Numerous international donors have supported the water sector. For the years 2011–2012 alone, the World Bank provided US$75 million for a variety of projects in Gaza and the West Bank. An example of these projects is the Gaza Emergency Water Project II (GEWP II). The project has been key in ensuring that the Coastal Municipalities Water Utility is able to maintain services through efficient and effective emergency financing (Fanack Water, 2015). Another example in Gaza is the financing for the North Gaza Emergency Sewage Treatment facility by the European Union, the World Bank and other donors. The North Gaza Emergency Sewage Treatment plant is to have a treatment capacity of 12 mcm per year and become fully operational by mid-2020. It will largely replace the ageing and only partially operational Beit Lahya Wastewater Treatment Plant.

A third prominent, current project being funded in Gaza is the Central Desalination Plant and Associated Works Project, which will become the largest infrastructure project ever in Gaza, with an estimated cost of over US$608 million (€562 million). When completed, this desalination facility will provide an estimated 55 mcm of freshwater per year for Gaza's population. The European Union alone has pledged some US$83 million (€77 million) for the project. A donors' conference held in Brussels on 20 March 2018 succeeded in raising US$493 million (€456 million) in pledges, approximately 80 per cent of the total plant cost. The World Bank also announced in February 2020 that it would support the Gaza Central Desalination Program Associated Works Phase I Project, which will provide additional fresh water of 30 million cubic metres per year to 16 municipalities in the southern and middle governorates of Gaza by supporting the construction and rehabilitation of necessary infrastructure.

Picture from UNEP visit to the North Gaza Emergency Sewage Treatment plant (NGEST). Solar covers half of the plant's energy operation requirements. Re-charged water will be sent to the aquifer and then will be used for irrigation. Plans exist for bio-gas production in the future. (Ron Witt)

Water and the Sustainable Development Goals

According to the Palestinian government's Voluntary National Review submission on the 2030 Agenda, the Palestinian Water Authority leads the water, sanitation and hygiene sector through the development of the National Water and Wastewater Sector Strategy (2013–2032) (SP, 2018). The National Water Strategy provides the planning and management framework necessary for the protection, conservation and sustainable management of water resources (SP, 2018). This is a well-accepted and comprehensive international framework for advancing and improving access to "water for development" in the Palestinian context. Clearly, the achievement or even the partial achievement of several of the targets related to Sustainable Development Goal 6 on clean water and sanitation would be of great benefit to Palestinians, in terms of greater access to freshwater for drinking, sanitation, agricultural and industrial purposes, and improved human health.

7.5 Conclusion and suggested actions

In the water sector, underlying problems could be effectively addressed through greater investment in water and wastewater treatment, new power infrastructure, along with greater water or electricity purchases, rolled out in tandem with the needed utility reform along the lines of the Water Law and National Water Company Action Plan. These are all achievable with existing technologies but are hindered for both political and financial reasons (Efron, Fischbach, Blum, Karimov, & Moore, 2018). A continuation of the *status quo* will compound the current negative outcomes in the sector (World Bank, 2018a). Enhancing Palestinian-Israeli cooperation towards water resources management would offer mutual benefits.

Major technological advances in the manufacturing of non-conventional water sources, both in the treatment and reuse of wastewater and in the development of seawater desalination, have important implications. (Eran, Bromberg, & Giordano, 2018). The World Bank, noting that Israel is a world leader in water efficiency and reuse technologies, calls for the transfer of technology to help ensure that the West Bank and Gaza can manage desalination, wastewater treatment and reuse, and agricultural technologies for demand management. Israel "has a tangible interest in improved environmental management" in the occupied Palestinian territory (World Bank, 2018a).

The World Bank has proposed future pathways and solutions in the water sector and for Palestinian-Israeli cooperation (World Bank, 2018a); (World Bank, 2018b). These include: accelerating key infrastructure projects such as the Central Desalination Plant in Gaza and wastewater treatment plants both in Gaza and the West Bank, with Israel's cooperation; strengthening the capacity of the Palestinian Water Authority as the leading entity for water sector reform; considering greater Palestinian purchases of freshwater

from Israeli desalination facilities and Mekorot at favourable prices; rainwater harvesting to increase potable water for Palestinians; and pushing forward reforms to reduce losses from the water distribution system. A water quality and health monitoring programme is also proposed (World Bank, 2018a). Enhancing wastewater treatment in Gaza is crucial; without this, investment in desalination will not yield full benefits for the people of Gaza.

The World Bank further calls for a reframing of the dialogue between the Palestinian Authority and Israel around water issues, with a focus on cooperation. “Water insecurity”, according to the Bank, is a “risk multiplier”, which can “intensify perceptions that the government is unwilling or unable to meet the needs of its citizens… It is clearly in the best interest of all regional players to both avert internal fragility and to mitigate regional fragility. Shared commitment and action towards water security in the West Bank and Gaza mitigates these risks” (World Bank, 2018a).

Given the interdependence of transboundary water systems, coordinated management of the shared resources is necessary to ensure that these resources are used in a sustainable manner. Israeli institutions have repeatedly emphasized the need for shared water management: in 2009, the Israel Water Authority observed that “Solving the problem of water scarcity in one country at the expense of another that shares a common water source is unacceptable and will only intensify tensions and difficulties” (IWA, 2009); and an Israel Nature and Parks Authority evaluation concluded that “Cooperation between Israel, the Palestinian Authority and donors may make the process of establishing sewage infrastructures more efficient, thereby reducing the extent of river pollution and water shortage.” (Cohen, 2016). A joint focus on practical and effective planning for coordinated water resources management is now urgently needed in light of projected changes to the climate.

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Chapter 8: Air quality and climate change

8.1 Introduction

This chapter examines both air quality and climate change in the occupied Palestinian territory, current and potential implications of changes, and institutional responses. As noted above, the Eastern Mediterranean region is considered particularly vulnerable to the impacts of anthropogenic climate change, in part because extreme climate conditions are already common, and climate change impacts will, therefore, be disproportionate. Weaknesses in systems for environmental governance and management, combined with other stresses created by the political and economic situation, may render Palestinians especially vulnerable to the impacts of climate change and variability.

8.2 Status and trends of ambient air

The Palestinian Environmental Law 1999 defines air pollution as 'any change in the characteristics or components of the natural air, which may cause harm to the environment'. Air pollution is characterized by the presence of particulate matter in the air of the atmosphere. Air pollution originates from natural and man-made sources. Natural sources are forest fires, dust storms and volcanic eruptions. Human activities that are major sources of outdoor air pollution include:

- Fuel combustion from motor vehicles (cars and heavy-duty vehicles);
- Heat and power generation (oil and coal power plants and boilers);
- Industrial facilities (manufacturing factories, mines and oil refineries);
- Municipal and agricultural waste sites and waste incineration or burning; and
- Residential cooking, heating and lighting with polluting fuels.

The pollutants with the strongest evidence of health effects are particulate matter (PM), ozone (O3), nitrogen dioxide (NO2) and sulphur dioxide (SO2) (WHO, 2019b).

Trends in current levels and concentration of major pollutants in ambient air have been increasing due to growing emissions and number of pollution sources particularly from within and around urban areas. Key sources of pollutants include industries, transport, transboundary air pollutants, cooking fires, open burning of solid waste and charcoal kilns (PCBS, 2016); (EEA, 2014). Increased dust

storms have been observed and these may be caused in part by the changing climate (Parolari, Li, Bou-Zeid, Katul, & Assouline, 2016).

Industrial emissions

The numerous factories and other industrial activities in the industrial zones emit smoke, and hazardous and toxic gases in large quantities (EEA, 2014). Industrial pollution is a major contributor to the increasing emissions in West Bank. For instance, a study of 600 industrial facilities in the West Bank showed that emission of total suspended particles, the most predominant pollutant, was 6,341 tonnes/year. Other pollutants include PM10 at 3,749 tonnes/year, NOx at 317 tonnes/year, SO2 at 18 tonnes/year and volatile organic compounds at 2,395 tonnes/year (EQA, 2015). Quarrying and stone cutting generate significant air pollution effects in several areas, notably Hebron (World Bank, 2019). Of 15 quarries currently operating in Area C of the West Bank, seven are under Palestinian ownership and eight are under Israeli ownership (GoI, 2019). Air pollution is emitted by charcoal kilns in the northern West Bank (GoI, 2019).

The indoor and outdoor particle concentration distributions of PM_{10}, $PM_{5.0}$, $PM_{2.5}$, and $PM_{1.0}$ were measured between 2014 and 2015 along four roadsides and four urban homes in Nablus (Jodeh, et al., 2018). Human and industrial activities in Nablus explain the differences in the results between the roadside and the urban areas. Concentrations of particulate matter peak during the summer months of June and July. Along roadsides, this could be attributed to heavy industrial activities during these months. Similar patterns were observed for urban areas with particulate matter that were higher during the summer, with annual averages of PM_{10} and $PM_{2.5}$, more than five times the values for both indoor and outdoor situations recommended in the World Health Organization Air Quality Guidelines (WHO, 2006), as summarized in table 15. During the winter months, buildings with poor ventilation recorded particulate matter from additional sources such as woodfires, gas burners, kerosene heaters and cigarette smoking.

Emissions due to transport

The current use of transport is a major source of environmental pollution, due to gas emissions from fuel combustion in vehicles, such as sulphur oxides, nitrogen oxides, carbon monoxide, suspension materials and others (EQA, 2010). The total emissions from the transportation sector make up more than 50 per cent of the total national emissions. Among the primary sources of air pollution are the exhaust fumes of more than 170,000 motor vehicles, the majority of which carry outdated or inefficient clean fuel technologies, thus producing significant amounts of nitrogen oxides, carbon monoxide and other pollutants (MoLG, 2016).

Table 14: Palestinian emissions quantity (tonne/year) from energy, agriculture and waste sectors by the emitted type, 2007–2011 (ARIJ, 2015)

Emissions	2007	2008	2009	2010	2011
CO_2	2,401,835	2,260,916	2,643,222	3,271,227	3,100,538
CH_4	13,584	13,198	13,120	13,983	14,852
N_2O	706	689	682	711	783
NOx	26,815	29,229	28,223	31,412	40,112
CO	137,805	242,765	152,276	158,158	283,190
NMVOC	37,019	36,200	38,171	44,123	46,552
SO_2	1,722	3,903	1,966	1,515	4,480

Table 15: Average annual concentration of $PM_{10,}$ $PM_{5.0}$, $PM_{2.5}$ and $PM_{1.0}$ measured between December 2014 to November 2015 for roadside and urban houses, indoors and outdoors in the study area (Nablus), compared to World Health Organization Guidelines values (Jodeh, et al., 2018).

Type of accommodation	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
Roadside houses • Outdoor • Indoor	 175.75 ± 44.78 156.25 ± 53.33	 130.17 ± 50.41 107.67 ± 36.87
Urban houses • Outdoor • Indoor	 142.83 ± 43.89 129.92 ± 38.86	 92.50 ± 21.96 84.17 ± 23.81
World Health Organization Air Quality Guidelines	20	10

± indicates the margin of error (+/-)

8.3 Health impacts

Air pollution is a major cause of disease and death globally, causing about 7 million premature deaths every year (World Health Organization). Particulate matter (PM), Ozone (O_3), Nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) are some of the pollutants with the strongest evidence for public health concern. The health risks associated with PM_{10} and $PM_{2.5}$ are especially well documented. With their small diameters, these particles can penetrate deep into lung passageways and enter the bloodstream, causing cardiovascular, cerebrovascular and respiratory disease. Short- and long-term exposure to indoor and ambient air pollutants may cause respiratory illnesses, cancer, and reduced lung function in children and adults (WHO, 2019a). According to an analysis published by the Institute for Health Metrics and Evaluation in 2017, air pollution ranked as the number 8 risk factor driving death and disability, after (1) malnutrition; (2) dietary risks; (3) high fasting plasma glucose; (4) high body-mass index; (5) high blood pressure; (6) high cholesterol; and (7) tobacco (IHME, 2017).

8.4 Responses for improved air quality control

The Palestinian Authority has issued a National Policy Agenda, which sets national priorities and action plans for the period 2017–2022. In this document, National Priority 10 is to reduce and effectively control pollution and greenhouse gas emissions and to increase energy efficiency and reliance on renewable energy to ensure the resilience of the Palestinian people (SP, 2016b).

The Palestinian Authority has been trying to tackle emissions from the largest contributor, the transportation sector, for several years. The Palestinian Authority adopted European Union regulations for all vehicles: this implies that each vehicle in the occupied Palestinian territory should have achieved a fleet-average CO_2 emission target of 130 g/km by 2015 for all new cars registered by the Palestinian Authority (Shaath & Sharbak, 2011). A legislative proposal for a draft regulation to reduce CO_2 emissions adopted by the European Commission in October 2009 set a long-term target of 135 g/km for 2020. These regulatory tools are expected to have a significant impact on urban pollutants including nitrogen oxide, carbon monoxide and CO_2 emissions by passenger cars and light commercial vehicles in the coming years.

The Palestinian Authority also developed a strategic action plan to reduce the pollution of vehicle exhaust gases, which included three main actions (Shaath & Sharbak, 2011): reduce the percentage of old cars on the road, increase the use of public transportation, and adopt clean fuel types. Transport targets expressed in nationally determined contributions to the United Nations Framework Convention on Climate Change includes 20 per cent of trucks and buses using

compressed natural gas by 2040 and a 25 per cent shift from private cars to public buses by 2030.

The Israeli authorities have undertaken several initiatives to control air pollution from illegal waste burning and from charcoal kilns in the northern West Bank, including enforcement activity and development of alternative charcoal production technologies (GoI, 2019).

8.5 Climate change in the occupied Palestinian territory

Some of the key sectors impacted by climate change include agriculture, water, health, tourism and urban infrastructure. Climate change impacts may result in socioeconomic losses affecting livelihoods and human well-being, for instance when food security and the agri-food sector are threatened. The following sections give an overview of climatic trends, their implications, and the responses from government and communities to adapt to ongoing changes and to mitigate future losses.

Past trends in temperature and rainfall
Temperature is one of the indicators used as evidence to track climate change. An assessment of historical climate trends in the occupied Palestinian territory undertaken as part of the preparation of the National Adaptation Plan and the Initial National Communication Report to the United Nations Framework Convention on Climate Change reached confidence conclusions shown in table 16 (SP, 2016a).

Temperature and rainfall projections
The three future climate scenarios for the occupied Palestinian territory that have been developed to be representative of all projections considered by the Fifth Assessment Report of the United Nations Intergovernmental Panel on Climate Change are summarized below in tables 17, 18 and 19 (EQA, 2016). Increases in temperature are likely to lead to a decline in water supply, resulting in a decline in agricultural yields, increasing water demand (combined with an increasing population) and a subsequent decline in the supply of freshwater.

Table 16: Historic trends in climate (SP, 2016a).

Parameters	From the perspective of change
Average temperatures	Very high confidence that temperatures have risen over the past 100 years but less confidence in quantitative rates of change, due to spatial and temporal dependencies and data quality.
Temperature extremes	High confidence that warm days/nights and cold days/nights have increased/decreased respectively in frequency.
Rainfall totals	Very low confidence that annual and seasonal rainfall totals have changed in either direction over the past 50 years or so, but also very low confidence that there has been no change in annual and seasonal rainfall totals.
Rainfall extremes	Only very low confidence can be ascribed to changes in rainfall because of the limited evidence combined with the relative rarity of such events.
Oceanic parameters	There is high confidence that sea level has increased in general over recent decades, but low confidence in the magnitude of that increase or in the variability of that increase over time.

Table 17: Scenario 1. The most optimistic scenario, most likely should emissions be controlled according to the Intergovernmental Panel on Climate Change target of a global average temperature increase not exceeding 2°C.

Temperature	Increases by ~1°C by 2025, ~1.5°C by 2055 and ~2°C by 2090
Temperature-related	Less frequent cold periods and more frequent warmer periods, with both becoming increasingly prominent over time.
Rainfall	Does not change, or perhaps increases slightly in the period to about 2035.
Rainfall-related	A slight possibility of more flooding; a small possibility of increased periods of drought but, in general, limited change overall to rainfall characteristics.

Table 18: Scenario 2. A mid-range scenario, most likely should emissions continue to increase along recent lines with some reductions from historic levels but breaching the 2°C target.

Temperature	Increases by ~1°C by 2025, ~2°C by 2055 and ~3°C by 2090
Temperature-related	Less frequent cold periods and more frequent warmer periods, with both being more prominent over time (more so than under scenario 1).
Rainfall	Decreases by ~10% by 2025, ~15% by 2055, and ~20% by 2090.
Rainfall-related	Little, probably no, possibility of increased flooding risk. High likelihood of more frequent droughts. Perhaps overall less rainfall per day of rain on average.

Table 19: Scenario 3. The most pessimistic scenario, assuming that emissions continue unabated

Temperature	Increases by ~1.5°C by 2025, ~2.5°C by 2055 and ~4.5°C by 2090
Temperature-related	Less frequent cold periods and more frequent warmer periods, with both being increasingly prominent over time (perhaps moderated slightly in the Gaza Strip).
Rainfall	Decreases by ~20% throughout until 2055 and ~30% by 2090.
Rainfall-related	Generally, a pattern of reductions in average daily rainfall and in contributions to total rainfall by heavier rainfall days, extended dry periods and reduced wet periods; thus an increase in drought risk throughout. However, there is an indication that the rare wettest days might become more frequent, particularly in the West Bank, thus raising the possibility of an increased flood risk.

Table 20: National Greenhouse Gas Inventory for 2016 (PCBS, 2016)

Categories	CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	Emissions ('000 tonnes of CO_2 eq)
Total national emissions and removals	3,254.50	44.2	1.5	4,645.50
Energy	3,286.10	2.4	0.1	3,381.80
Fuel combustion activities	3,286.10	2.4	0.1	3,381.80
Energy industries	331.3	0	0	333.9
Manufacturing industries and construction	69	0	0	69.5
Transport	2,320.90	0.4	0.1	2,365.70
Other sectors	564.9	1.9	0	612.7
Fugitive emissions from fuels	0	0	0	0
Industrial processes and product use	NO	NO	NO	0
Agriculture, forestry and other land use	-31.6	8.2	0.7	369.6
Livestock	0	8.2	0	172.5
Enteric fermentation	NO	7.1	NO	148.6
Manure management	NO	1.1	1.0	23.9
Land	-31.6	0	0	-31.6
Forest land	-31.6	0	0	-31.6
Aggregate sources and non-CO_2 emissions sources on land	0	0	0.7	228.7
Direct NO_2 emissions from managed soils	0	0	0.7	210.2
Indirect NO_2 emissions from manure management	0	0	0.1	18.4
Waste	0	33.6	0.6	564.9
Solid waste disposal	0	15.7	0	329.2
Wastewater treatment and discharge	0	17.9	0.6	564.9

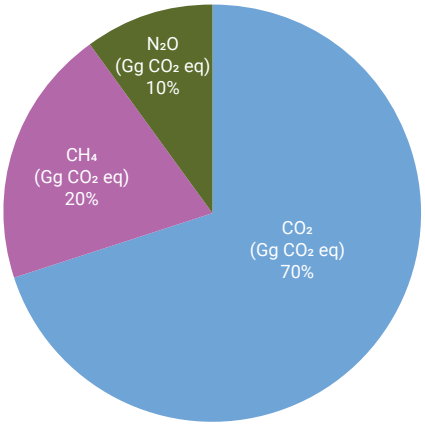

Figure 19
Total national emissions and removals, 2016 (PCBS, 2016)

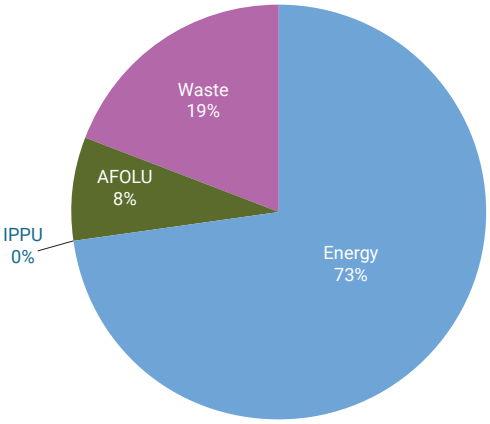

Figure 20
Sector-wise emissions, 2016 (PCBS, 2016)

Greenhouse gas emission trends
The State of Palestine National Greenhouse Gas Inventory for 2016 is summarized in table 20. The energy sector contributes 72.7 per cent – the largest share to the total CO2 emissions – followed by waste and then agriculture, forestry and other land use sectors.

Figures 19 and 20 represent the shares of total emissions by type of gas and by sector respectively.

Indirect greenhouse gases and fluorinated gases
The emissions of the indirect greenhouse gases (CO, NO_x, NMVOCs and SO_x) have not been estimated as the State of Palestine is a non-Annex I party to the United Nations Framework Convention on Climate Change and therefore not obliged to estimate and report them.

8.6 Vulnerability to climate change impacts

Projected changes in temperature and rainfall trends make some key sectors highly vulnerable, with severe implications for the Palestinian economy, living standards and the environment. The most vulnerable receptors are in the sectors of agriculture, coastal and marine ecosystems, energy, food, health, industry, terrestrial ecosystems, urban areas and infrastructure, tourism, waste and wastewater, and freshwater. These issues have been highlighted in the National Adaptation Plan. A number of these impacts have been explored in detail below, and issues ranked as 'highly vulnerable' are summarized in table 21.

Agriculture and food
According to the United Nations Economic and Social Commission for West Asia Arab Climate Change Assessment Report, "agriculture is the sector most sensitive to climate variability and change in the West Bank" (UNESCWA, 2017). The West Bank produces 85.6 per cent of Palestinian agricultural goods. Climate-sensitive crops include olives, grapes, stone fruit and rain-fed vegetables (SP, 2016a). Other issues within the agricultural sector in the West Bank include the degradation of grazing areas, soil erosion, reduced availability of water for irrigation and livestock production, among others (Tippmann & Baroni, 2017).

The Gaza Strip supports 14.4 per cent of all agriculture. Climate-related issues in Gaza are similar to those in the West Bank (Tippmann & Baroni, 2017). Here, the cost of agricultural production will be impacted due to shortages of water for irrigation, which in turn will have implications for vegetable, oil and citrus production. These changes will also impact employment in the agriculture sector. Agriculture accounts for 6 per cent of employment, and contributes 3 per cent to Palestinian gross domestic product. According to the Food and Agriculture Organization of the United Nations, agriculture contributes 12 per cent of all Palestinian

Table 21: Issues ranked as "highly vulnerable" to climate change (SP, 2016a)

Theme/sector	Highly vulnerable – West Bank	Highly vulnerable – Gaza Strip
Agriculture	Olive production Grape production Stone fruits Rain-fed vegetables Field crops Irrigated vegetables Grazing area and soil erosion Irrigation water Livestock production	Livestock production Cost of agricultural production Employment Vegetable production Olive production Citrus Irrigation water
Coastal and marine	N/A	Fishing/fisheries Coastal agriculture Condition of beaches
Energy	Domestic/local energy production Energy imports Condition of infrastructure	Domestic energy production Energy imports Condition of infrastructure
Food	Domestic food prices Imported food prices	Domestic food prices Imported food prices
Gender	Major diseases related to water and sanitation	Employment and gender Major diseases related to water and sanitation Food security and gender
Health	Major diseases related to water, sanitation and food	Major diseases related to water, sanitation and food
Industry	Value of raw materials imported Infrastructure Energy supply Energy demand	Value of industrial products exported Value of raw materials exported Employment Energy supply Energy demand
Terrestrial ecosystems	Habitat connectivity	Wadi Gaza – habitat connectivity
Tourism	Condition of cultural heritage	N/A
Urban and infrastructure	Urbanization	Building conditions Urban drainage
Waste and wastewater	Waste management	Waste management
Water	Groundwater supply Flood management Condition of infrastructure	Groundwater supply Groundwater quality Flood management

exports, with agro-industries contributing an additional 19 per cent: a total of 31 per cent of all Palestinian exports are therefore related to agriculture.

Food production is highly climate-sensitive. As a result, access, availability, utilization and stability will be affected by the impacts on the agricultural sector. Examples from previous years demonstrate that increases in food prices, especially during episodes of unfavourable weather, makes nutritious food unaffordable especially for low-income households (OCHA, 2018). Palestinians also depend heavily on imported foods. Post-harvest losses are high because of limited adequate storage facilities, meaning that food cannot be stored when world food prices are low. According to the Palestinian Expenditure and Consumption Survey 2017, food expenditures consisted of 29 per cent of total household expenditure in the West Bank, compared to 36 per cent in the Gaza Strip.

In terms of fisheries, fish are most abundant between 100 m and 200 m from the shore and higher temperatures encourage the relocation of fish into cooler and deeper waters. Combined with ocean acidification due to increasing levels of dissolved CO_2 in the oceans, climate change has negative implications for the quality and quantity of the fish catch. (SP, 2016a).

Water

Water shortages described in Chapter 7 are likely to intensify as a result of climate change. Reduced rainfall and high-intensity rainfall result in reduced groundwater recharge. High temperatures increase

Box 12: Droughts in the Mediterranean Basin and the Middle East

The Intergovernmental Panel on Climate Change (IPCC), in Chapter 3 of its special report on the impacts of global warming of 1.5 °C above pre-industrial levels, describes the Mediterranean Basin and the Middle East as "an example of a region with high vulnerability where various adaptation responses have emerged".

The IPCC describes a "long history of resilience to climatic change" in the eastern Mediterranean region, which "has experienced a strong negative trend in precipitation since 1960 (Mathbout et al., 2017) and an intense and prolonged drought episode between 2007 and 2010 (Kelley et al., 2015). This drought was the longest and most intense in the last 900 years (Cook et al., 2016)." Noting evidence of "a steep decline in agricultural productivity in the Euphrates and Tigris catchment basins, and displaced hundreds of thousands of people, mainly in Syria" as a result of this drought, the IPCC notes that many "historical periods of turmoil have coincided with severe droughts, for example, the drought which occurred at the end of the Bronze Age approximately 3,200 years ago (Kaniewski et al., 2015)". Historically, people living in regions vulnerable to climate change have been "forced to pursue drastic adaptive responses, including migration and societal structure changes".

With reference to the Mediterranean Basin and the Middle East, the IPCC further notes that "the potential evolution of drought conditions under 1.5°C or 2°C of global warming (Section 3.3.4) can be analysed by comparing the 2008 drought (high temperature, low precipitation) with the 1960 drought (low temperature, low precipitation) (Kelley et al., 2015). Though the precipitation deficits were comparable, the 2008 drought was amplified by increased evapotranspiration induced by much higher temperatures (a mean increase of 1°C compared with the 1931-2008 period in Syria) and a large population increase (from 5 million in 1960 to 22 million in 2008). Koutroulis et al. (2016) reported that only 6 per cent out of the total 18 per cent decrease in water availability projected for Crete under 2°C of global warming at the end of the 21st century would be due to decreased precipitation, with the remaining 12 per cent due to an increase in evapotranspiration. This study and others like it confirm an important risk of extreme drought conditions for the Middle East under 1.5°C of global warming (Jacob et al., 2018), with risks being even higher in continental locations than on islands; these projections are consistent with currently observed changes (Section 3.3.4; Greve et al., 2014). Risks of drying in the Mediterranean region could be substantially reduced if global warming is limited to 1.5°C compared to 2°C or higher levels of warming (Section 3.4.3; Guiot and Cramer, 2016). Higher warming levels may induce high levels of vulnerability exacerbated by large changes in demography." (Hoegh-Guldberg, et al., 2018).

the demand for water and increase the amount of water discharged from aquifers. Drought conditions lead to ever-decreasing amounts of available groundwater (EQA, 2016).

There is a heavy reliance on rainfed agriculture (94 per cent of the agricultural area in the West Bank) (EPME, 2019). "Agricultural livelihoods, particularly within rural rainfed farming communities, are always directly affected by rainfall and drought incidence. Rainfall reduction and variability are the most important climate risk to rural livelihoods, and can lead to severe negative effects on agricultural yields: completely altering a growing season if a reduced or delayed rainfall event occurs, for example." (ESCWA, 2017)

Climate change is likely to exacerbate strains on water management structures, which are (as described in Chapter 7) already facing severe challenges. The potential for water harvesting is underutilized, and institutional arrangements to manage the shared aquifer systems are absent (EQA, 2016). Weak institutions mean that activities such as deepening and rehabilitation of wells, protection of springs, and implementation of small-scale desalination units are limited, absent or unsustainable due to lack of support.

Energy

In the occupied Palestinian territory, only 5.27 per cent of annual electricity demand is met by internal production. The annual electricity consumption is 1,193 kWh per capita. This compares with 1,865 kWh per capita for Jordan, and 6,601 kWh per capita for Israel (World Bank, n.d.) (figures for 2014). During times of extreme temperatures energy demand increases (SP, 2016a).

Due to the lack of adequate facilities to store feedstocks, the ability to produce domestic energy from feedstocks is sensitive to climate, and is seasonally affected if demand suddenly increases due to climate variability. In addition, systems for distributing feedstocks are inefficient and are affected by extreme climate events. Palestinians are heavily reliant on energy imports from Israel. The weak electricity grid and vulnerability to extreme weather conditions leaves people exposed to energy insecurity. Interruptions in electricity supply also affect water pumping and wastewater treatment, especially during extreme weather events. Apart from electricity, all petroleum products are also imported through Israeli petroleum companies. This fuel is transported by tankers and, hence, the reliability of the supply is sensitive to weather and road conditions (SP, 2016a).

Salinity of coastal aquifer and coastal erosion in Gaza

The salinity of the Coastal Aquifer is already a major concern, as noted above. Sea level rise (currently 1.5 mm per annum) will accelerate coastal erosion and increase saltwater intrusion. Sea level rise will also increase wave impact and accelerate coastal erosion, thereby reducing the quality of beaches, damaging harbours and other coastal structures, and potentially leading to the collapse of the coastal beach cliff (SP, 2016a).

8.7 Adaptation

Adaptation is defined as "adjustments in human and natural systems, in response to actual or expected climate stimuli or their effects that moderate harm or exploit beneficial opportunities" (IPCC, 2019). The State of Palestine became a Party to the United Nations Framework Convention on Climate Change in March 2016 and signed and ratified the Paris Agreement soon after. The first nationally determined contribution was submitted in 2017; this is consistent with the Initial National Communication Report and the National Adaptation Plan, which were reviewed and approved by stakeholders in 2016 (SP, 2017a). The National Adaptation Plan lists the adaptation priorities and plans for highly vulnerable sectors.

The adaptation measures ranked 1 and 2 for the highly vulnerable issues for each sector in the West Bank and the Gaza Strip are summarized below, together with the total costs of each (SP, 2017b). The expected cost of all adaptation measures combined, implemented over 10 years, is estimated at US$3,544 million.

In addition, the State of Palestine has unconditionally committed to undertake the specific adaptation actions set out in table 24. Many of these reflect adaptation actions that are undertaken locally, but need to be scaled up and implemented more widely or are currently in the process of implementation, as set out in the National Action Plan (SP, 2016a); (SP, 2017b).

Table 22: Summary of most important adaptation measures by ranking (SP, 2017b)

Sector	Region	Most crucial adaptation measures	Total adaptation fund (US$ million)
Agriculture	West Bank	Enhance sustainable community-level irrigation schemes and infrastructure.	19.40
		Climate-smart agriculture	146.00
	Gaza Strip	Climate-smart agriculture: management of crop production systems including soil and water resources for better environmental sustainability along with improved economic profitability for farmers	40.40
		Improve water-use efficiency and using alternatives water resources	14.27
Coastal and marine	Gaza Strip	Rainwater harvesting	0.50
		Construction of detached breakwaters	10.00
Energy	West Bank	Generation of solar electricity for medium to large scale commercial and industrial application	99.55
		Use of renewable energy such as solar to reduce imported energy	106.05
	Gaza Strip	Additional supply of energy from neighbouring countries	10.00
		Enhance the equipment and efficiency of the Gaza Power Plant	10.00
Food	West Bank	Enhance agricultural value chain and improving infrastructure for livestock- production	227.50
		Greenhouse management	25.00
	Gaza	Enhance agricultural value chain and improving infrastructure for livestock production	121.25
		Greenhouse management	12.50

Sector	Region	Most crucial adaptation measures	Total adaptation fund (US$ million)
Gender	West Bank	Increase the awareness of people, particularly women, in water-poor areas of measures they can take to help prevent major diseases related to water, sanitation and food	2.20
	Gaza Strip	Increase the awareness of people, particularly women, in water-poor areas of measures they can take to help prevent major diseases related to water, sanitation and food	3.20
		Support improvements in the efficient use of water in women's private small-scale agricultural projects	3.00
Health	West Bank	Development of water, food and sanitation monitoring and safety systems using high technology	5.85
		Train health professionals and increase the awareness of people, particularly women, in water-poor areas about measures they can take to help prevent major diseases related to water, sanitation and food	2.68
	Gaza	Train health professionals and increase the awareness of people, particularly women, in water-poor areas about measures they can take to help prevent major diseases related to water, sanitation and food	0.85
		Development of water, food and sanitation monitoring and safety systems using high technology	2.90
Industry	West Bank	Provide reliable electricity supply	29.40
		Replace imported raw materials with local materials whenever possible	28.00
	Gaza strip	Improve handling, fumigation, packaging and storage techniques for raw materials intended for export	1.00
		Capacity-building to enable industries to adapt to climate change	4.00
		Rehabilitation of industrial facilities	30.00

Sector	Region	Most crucial adaptation measures	Total adaptation fund (US$ million)
Terrestrial Ecosystems	West Bank	National network of protected areas, including 50 protected areas and 51 biodiversity hotspots	12.00
	Gaza Strip	National network of protected areas, including Wadi Gaza and three biodiversity hotspots	1.40
Tourism	West Bank	Identify, design and implement flood management schemes for cultural heritage sites, where appropriate	4.80
		Identify, design and implement flood management schemes for eco-tourist attractions, where appropriate	4.80
Urban Infrastructure	West Bank	Promote green buildings	10.00
		Rehabilitation of resilient road infrastructure	21.00
	Gaza Strip	Rehabilitation of resilient road infrastructure	10.00
		Promote green buildings	12.60
Waste and Wastewater	West Bank	Improve waste collection system	34.25
		Improve management of leachate from landfill sites	5.00
	Gaza Strip	Improve waste collection system	12.00
		Improve management of leachate from landfill sites	2.00
Water	West Bank	Rehabilitate water sources: wells, canals and springs	4.40
		Control of leakage from distribution systems	16.50
	Gaza Strip	Increase share of imported water	1.00
		Enhance the use of alternative water resources for non-domestic purposes	61.00

Table 23: Total cost of implementing adaptation measures from Table 22 (in millions US$) (SP, 2016a).

Sector	West Bank total costs (US$)	Gaza Strip total costs (US$)	Total costs (US$)
Agriculture	1,024.40	212.94	1,237.34
Coastal and marine	-	114.00	114.00
Energy	267.05	176.00	443.05
Food	289.50	153.75	443.25
Gender	2.20	9.40	11.60
Health	8.53	3.75	12.28
Industry	171.80	77.50	249.30
Terrestrial ecosystems	12.00	1.40	13.40
Tourism	9.60	-	9.60
Urban and infrastructure	31.00	22.60	53.60
Waste and wastewater	47.25	16.00	63.25
Water	311.30	582.20	893.50
Grand Total	2,174.63	1,369.54	3,544.17

Table 24: Adaptation actions to be unconditionally implemented (SP, 2017b).

Adaptation action	Brief description of action
Enhancing food security (Jenin, Tubas, Ramallah)	• Implemented by the Ministry of Agriculture
Land, water and human resources development in marginalized areas (Hebron, Bethlehem)	• Increase water availability by constructing cistern and earthy dams, and improved irrigation by installing water tanks.
Rehabilitation of agricultural land (Salfit, Bethlehem, Hebron, Jenin)	• Implemented by the Ministry of Agriculture
Land development and water resources project (Jenin, Nablus, Qalqylia, Tulkarem, Hebron)	• Increase water availability by constructing a 2,000 m³ capacity storage lagoon. • Improve irrigation scheduling by installation of 10 water tanks. • Minimize water leakages by installing new water conveyance systems.
Integrated rural development project (Marj Sanour)	• Increase water availability by: - constructing 50 storage lagoons (5,000– 10,000m³ each) - constructing 15–170 cisterns (70m³ capacity each) - rehabilitating 500 dunums of sloped terrain to minimize soil erosion
• Water harvesting project – 2 dams and pond (Hebron district, Jenin)	• Increase water availability in the agricultural sector by constructing 3 large scale earthy ponds with a total capacity of 300,000 m³.
• Adaptation to climate change project (Tulkarem, Jenin, Jericho, Ramallah, Dora)	Improve farmers' and agricultural engineers' adaptive capacity through improved irrigation management, treated wastewater reuse, introducing new fodder seeds and minimizing soil erosion through minimal tillage.
• Water harvesting and soil conservation project to adapt to climate change (Jenin, Ramallah, Dora)	Soil water harvesting to improve water availability and soil quality, and build adaptation capacity in the agricultural sector with respect to soil water harvesting.
• Water harvesting project –rainwater collecting wells (Hebron)	• Increase water availability in the agriculture sector (animal and crops) by constructing 50 cisterns (approximately 70–100m³).
• Water management project (Jordan Valley, Nablus)	• Improve water management and increase available water by rehabilitating 6 wells and 10 km of conveyance infrastructure.
• Enhancing food security (Jenin)	• Improve food security by planting 200 dunum of alfalfa
• Enhancing food security (Jenin, Nablus)	• Increase food security by cultivating 100 dunum in Jenin and 100 dunum in Nablus with food crops and reusing treated wastewater.

8.8 Mitigation

In recognition that carbon dioxide emissions from the energy sector are a major contributor to climate change, the State of Palestine pledged to reduce carbon dioxide emissions through its Intended Nationally Determined Contributions (INDCs) arising from the 2015 Paris Climate Agreement. The INDC was approved in August 2017. Although full implementation may be hindered by the current political situation, the main elements include capacity-building, technology transfer and financial support from development partners.

If the current political situation remains, the State of Palestine expects to achieve a reduction of carbon dioxide emissions by 12.8 per cent by 2040. Under a scenario of political breakthrough ("independence scenario"), an independent Palestinian state would reduce CO_2 emissions by 24.4 per cent by 2040 (SP, 2017a). Two scenarios are provided for the nationally determined contributions:

- Independence scenario: the State of Palestine achieves independence and is able to exercise full control over its resources; and
- Status quo scenario: reflects a continuation of Israeli occupation.

The Palestinian government will implement the mitigation actions set out in table 25, conditional on receiving international support.

Table 25: Mitigation actions to be implemented, conditional on receiving international support (SP, 2016a).

Mitigation action	Brief description of action
Solar photovoltaic	Generation of 20–33 per cent of electricity using solar photovoltaic. Energy service companies could be used to overcome financial barriers.
Energy efficiency in buildings	Building standards on thermal efficiency, expanding existing regulations.
Use of waste for cement production	Municipal solid waste used to substitute 20 per cent of coal in cement production. Acquired through contract tender to private organizations.
Use of waste for electricity generation	Deployment of a 1 MW (50 tonnes per day of waste) waste incineration unit.
Reduction of methane from landfill	Capture of 14,000 tonnes of landfill gases per annum for use in power generation.
Energy efficient lighting	Annual increase as part of building standards. Increase of 1 per cent per annum, using energy-efficient lightbulbs.
Hybrid electric vehicles	Promotional campaigns and maintenance/increase to tax credits for qualifying vehicles.
Compressed natural gas-powered vehicles	Development of compressed natural gas refueling infrastructure and amendment to the Traffic Act regarding license fees. Assumes that 20 per cent of trucks and buses could use compressed natural gas by 2040.
Modal shift programmes	Numerous measures including standard public service contracts, simplified fare systems, improved passenger information, and better vehicles and maintenance. Envisions a 25 per cent shift from private vehicle to public transport by 2030.
Afforestation	Annual increase of 200 hectares of forested land per annum, building on existing forested land.

Table 26: Mitigation actions to be implemented unconditionally (SP, 2016a)

Mitigation action	Brief description of action
Sustainable urban demonstration projects	Installation of six net-metering photovoltaic systems on six main public buildings in the Tubas Municipality as follows: • Municipality building • Public information centre • Cafeteria building – public transportation • Dynamo-meter building • Youth centre building • Storage building
Sustainable urban demonstration	Installation of a small-scale wastewater treatment plant powered by solar energy in Za'atara, and evaluation of the feasibility of upscaling this technology.

In addition, the Palestinian government committed to unconditionally undertake the mitigation action as given in table 26.

Financial, technology transfer and capacity-building needs

These needs are well articulated in documents submitted by the State of Palestine to the United Nations Framework Convention on Climate Change such as the National Adaptation Plan, Nationally Determined Contributions and Initial Communication report. Salient features are highlighted below:

Financial: The financial needs related to the cost of adaptation options in each theme/sector was estimated at US$3,544.17 million over the next 10 years. The State of Palestine estimates that it would require an additional US$2.12 million to build the capability to generate its own climate modelling inputs to its future national adaptation plans and national communications.

Technology transfer: There is a well-established market for solar and thermal technology, a developing market for photovoltaic, and technologies including energy-efficient lighting. However, other climate-related technologies for both adaptation and mitigation options are to be promoted.

Capacity-building: Capacity-building is needed in a host of areas related to reporting, mitigation, adaptation and climate finance. Research and systematic observations are required for the analysis of historical climate trends, climate-change scenarios, vulnerability and adaptation, greenhouse gas inventories and mitigation potential. Since the State of Palestine is a Party to the United Nations Framework Convention on Climate Change, in order to fulfil its obligation, some other key areas require capacity-building such as:

- Development of complete monitoring, reporting and verification and monitoring and evaluation systems;
- Identification, prioritization and development of nationally appropriate mitigation actions;
- Development of a low-emission development strategy;
- Negotiator training; and
- Capacities to create and draft a biennial update report.

8.9 Institutional arrangements, legal and regulatory framework for addressing climate change

The right to a clean environment is enshrined into the Palestine Constitutional Framework supported by the following legislation pertaining to various elements of the environment (EQA, 2017).

- **Constitutional Framework**
  Article 33 of the amended Palestinian Basic Law of 2003 considers a clean and balanced environment to be a human right;
- **Law No. (7) of 1999 concerning the environment**
  This law deals with climate change through three topics: objective and general principles, the special conditions of the aerobic environment and environmental impact assessment, and reference to relevant international treaties;
- **Other legislation complementary to environmental law**
  3.1 Legislative decree No. 14 of 2014 on water
  3.2 Amended Law No. 2 of 2003 on agriculture
  3.3 Law No. 1 of 1999 on natural resources
  3.4 Law No. (12) of 1995 on the establishment of the Palestinian Energy Authority
  3.5 Legislative decree No. 14 of 2015 on renewable energy and energy efficiency
  3.6 Law No. (1) of 1997 on local authorities
  3.7 Legislative Decree No. (10) of 2011 on the law of industry

The Palestinian Environment Quality Authority is the main institution entrusted with the responsibility to monitor and protect the Palestinian environment. The Environment Quality Authority is the National Designated Authority to the Green Climate Fund. Since climate change is a cross-cutting issue, other sectoral ministries such as the Ministry of Agriculture, the Palestinian Water Authority, the Palestinian Energy and Natural Resources Authority, the Ministry of Transport, the Department of Meteorology, the Ministry of Local Government, the Ministry of Finance and Planning, the Ministry of National Economy and the Ministry of Health are required to work with the Environment Quality Authority on climate change issues.

Following its ratification of the Paris Agreement on 22 April 2016, the State of Palestine issued a National Adaptation Plan to Climate Change, nationally determined contributions, the Initial National Communication Report, and a Roadmap for Climate Action to implement the Initial National Communication Report, as stipulated by the Convention. Through these efforts, the Environment Quality Authority succeeded in identifying and assessing vulnerable sectors and describing historic trends in climate, climate sensitivity and the adaptive capacity of 12 sectors.

As described above, the Palestinian Government assessed greenhouse gas mitigation scenarios for all economic sectors under two scenarios: the 'independence pathway' and the 'status quo' pathway. The Environment Quality Authority identified adaptation measures for each sector including the prioritization score, estimated cost, future developments to participate in climate-change modelling research, monitoring and evaluation, and alignment of donor programmes and activities with the National Action Plan's focal themes/sectors. These exercises included constraints and gaps, and related financial, technical, and capacity needs to the three main elements: greenhouse gas inventory, mitigation assessment, and vulnerability and adaptation assessment. Furthermore, the information considered relevant to achieving the objectives of the Convention on technology transfer, research and systematic observation, capacity-building, and information and networking were emphasized.

8.10. Conclusion and suggested actions

Air quality and climate change have both environmental implications and socioeconomic ramifications for Palestinians. The Palestinian population is currently exposed to air pollution levels that exceed World Health Organization Guidelines ($PM_{2.5}$ air pollution); (MoLG, 2016).

Palestinians are highly vulnerable to climate change impacts. Water and food availability are expected to be affected climate change, with significant implications for other sectors. The cost of adaptation is estimated at US$3.5 billion over the next 10 years, and the total cost of implementing the mitigation actions, as set out in the Nationally Determined Contributions, is US$10.6 billion. The mitigation actions proposed in the Nationally Determined Contributions can only be delivered with appropriate international support (SP, 2017b). Timely adaptation and mitigation

policies and their effective implementation will play a crucial role in improving stability and prosperity in the coming decades. In this context the following actions are suggested:

- Seek donor support to meet the transport targets expressed in the Nationally Determined Contributions (NDC) to UNFCCC: this includes 20 per cent of trucks and buses using compressed natural gas by 2040 and shift by 25 per cent from private cars to public transport by 2030 (IsDB, 2018);
- Develop and implement a standardized air quality control and monitoring programme for key air pollutants such as sulphur dioxide (SO_2), oxides of nitrogen such as NO_2, and respirable fine particulate matter (PM10, $PM_{2.5}$) to determine the status and trends of ambient air quality at least in selected highly polluted areas. Regular measurements will help to monitor compliance with air quality standards;
- Update regulations on permissible emissions from vehicles and industries. Establish and put into operation vehicle testing and air quality monitoring centres around cities;
- Review thematic/sectoral strategies and policies to ensure they are aligned with the National Action Plan;
- Explore possibilities of joining a network of research institutions focusing on climate change impacts, vulnerability and adaptation, addressing both national and international climate policy needs, especially policy focused on adaptation to climate change;
- The Palestinian Authority should work with donors to build capacity for effective and efficient reporting, monitoring and verification, greenhouse gas inventory, mitigation, and financial support in order to fulfil its reporting requirements under the United Nations Framework Convention on Climate Change;
- The Environment Quality Authority, as National Designated Authority to the Green Climate Fund, should seek to establish a good financial governance structure to lay the foundation for climate-finance readiness. This includes the establishment of national climate-finance architecture and the integration of climate change into the public-finance system; and
- The Environment Quality Authority should work to attract further donor funding by establishing a National Climate Fund. Innovative finance options such as Green Bonds should be explored to help generate additional funds.

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Chapter 9: The urban environment

9.1 Status and trends of urbanization and demographics

Palestinian urban areas vary considerably, from large and densely populated cities to smaller West Bank villages. Refugee camps have separate governance arrangements and thus face different challenges from areas under Palestinian Authority jurisdiction.

Cities, towns and villages

Over three quarters of Palestinians (77 per cent) now live in urbanized areas, compared with slightly over 50 per cent of the global population (PCBS, 2018b). Around 15 per cent of the population is rural, with the remaining 8 per cent in refugee camps. The Palestinian urban population has almost tripled in the past 25 years (MoLG, 2016).

The Palestinian Authority defines an urban area as "any locality whose population amounts to 10,000 persons or more. This applies to all governorates or district centres, regardless of their size". It also refers to all localities whose population varies between 4,000 to 9,999 people and have at least four of the following: a public electricity network, a public water network, a post office, a health centre with a full-time physician, and/or a school offering a general certificate of secondary education. A rural area, on the other hand, is defined as any locality with a population of less than 4,000 people, or whose population varies between 4,000 to 9,999 people but lacks the four requirements mentioned above (MoLG, 2016).

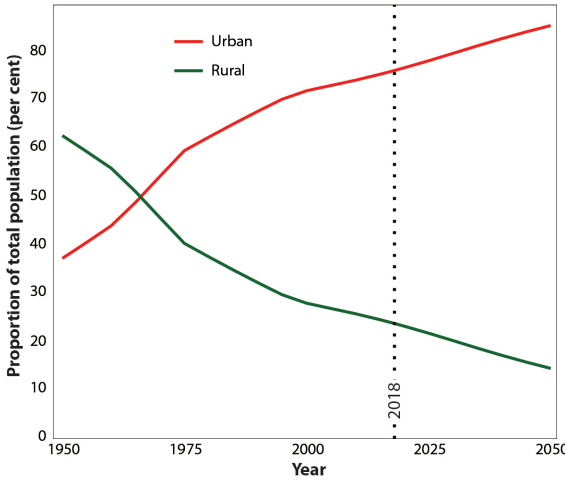

Figure 21
"Palestine's urban and rural population 1950–2050" (UNDESA, 2018)

According to the Palestinian Central Bureau of Statistics, the Palestinian population of East Jerusalem is 281,163. According to the Jerusalem Institute, East Jerusalem has a total population of 553,300 people, of whom 337,400 (approximately 61 per cent) are Palestinian (Korach & Choshen, 2019). The population of Gaza City is 678,669 (PCBS). The occupied Palestinian territory also includes five medium-sized cities (Khan Yunis, Jabalya, Rafah, Hebron and Nablus) with populations between 125,000 and 175,000 people each, the first three of these cities being in Gaza and the last two in the West Bank.

Political conditions have significantly affected recent urban development (Raddad & Samat, 2016). Israeli settlements in the West Bank, associated road infrastructure, and the separation barrier have

Table 27: Population, housing and establishment census 2017. Source: Palestinian Central Bureau of Statistics 2019.

City	Population
Gaza municipality	590,481
East Jerusalem*	281,163
Khan Yunis	205,125
Hebron	201,063
Jabalya	172,704
Rafah	171,899
Nablus	156,906
Deir al Balah	75,132
Qalqiliya	51,683
Jenin	49,908
Al Bireh	45,975
Ramallah	38,998
Bethlehem	28,591
Tubas	21,431
Jericho	20,907
Salfit	10,911

** East Jerusalem localities are: Kafr A'qab, Beit Hanina, Shu'fat Camp, Shu'fat, Al 'Isawiya, Sheikh Jarrah, Wadi al Joz, Bab as Sahira, As Suwwana, At Tur, Jerusalem (Al Quds), Ash Shayyah, Ras al A'mud, Silwan, Ath Thuri, Jabal al Mukabbir, As Sawahira al Gharbiya, Beit Safafa, Sharafat, Sur Bahir, Umm Tuba. This administrative area comprises East Jerusalem localities under Israeli control.*

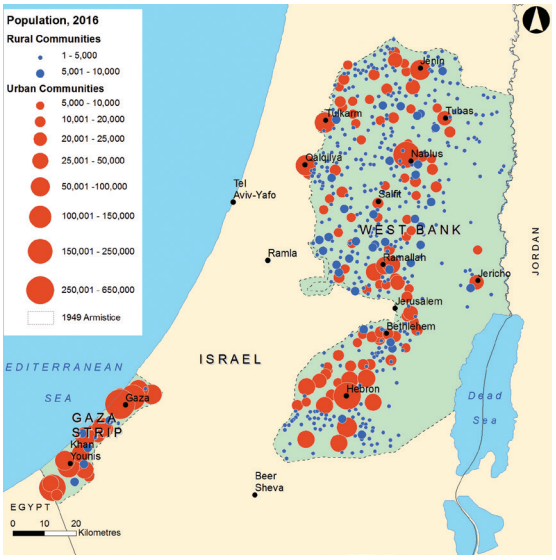

Figure 22
Population of Palestinian communities, 2016 (MoLG, 2016)

affected Palestinian mobility within Area C and across the West Bank (as described in Chapter 1). Palestinians often need to make detours that can be two to five times longer than the direct route to the nearest city, seriously affecting labour mobility and access to services. Finally, the physical separation of East Jerusalem, Gaza and the West Bank also severely hinders the movement of people and goods (SP, 2018). These restrictions have had particular impacts on women and girls, impeding their access to services and socioeconomic activities (UNESCWA, 2019).

Urban growth and urbanization rates

The growth rate of urban areas in 2015 was estimated at 3.2 per cent (El-Atrash, 2017), with an overall population density of 800 people/km2 in mid-2016. The population density in the Gaza Strip was 5,154 people/km2 compared to a lower population density in the West Bank of 519 people/km² PCBS (2016). An average Palestinian family has 5.1 individuals, 4.8 in the West Bank and 5.6 in Gaza, a decrease compared to the year 2007 when the average household size was 5.8 overall, or 5.5 in the West Bank and 6.5 in the Gaza Strip (PCBS, 2018a).

Refugees
Approximately 30 per cent of the population in the West Bank are refugees (1,047,990 people), most of whom (70 per cent) live outside refugee camps. In Gaza, approximately 73 per cent of the population are refugees (1,570,295 people), of whom 600,000 live in refugee camps. There are 8 refugee camps in Gaza and 19 in the West Bank. Overall, there are 58 Palestine refugee camps located in Lebanon, Syria, Jordan, Gaza and the West Bank (source: UNRWA).

Infrastructure
There have been some positive developments relating to infrastructure, including improved road and water networks, and the construction of transport facilities, although significant losses in infrastructure assets occurred during the years of the second intifada (Thawaba, et al., 2017).

Transportation
Modern road development dates back to the period of the British Mandate (1917–1948), when the road network was developed following paths of ancient historical roads. It consisted of a major north-to-south axis with smaller east-to-west roads, connecting major urban centres. At the time, the West Bank had a total road network of over 1,400 km. After the State of Israel was established, the West Bank came under Jordanian rule (1948–1967), and major changes in the road system took place, with longitudinal roads being built east of the Green Line (Thawaba, et al., 2017).

The current road network, as it has developed during the past decades, is far from adequate in terms of responding to the accessibility and mobility needs of Palestinian society. The total length of the road network is nearly 6,900 km, with over 6,200 km in the West Bank and over 600 km in Gaza. Some 55 per cent of roads are paved. According to the Ministry of Transport Strategic Plan for 2011–2013, the road types by length are: main roads, 936 km; regional roads, 782 km; internal local roads, 4,150 km; and bypass roads to Israeli settlements (which Palestinians are generally not permitted to use): 974 km. (Thawaba, et al., 2017). According to the United Nations Office for the Coordination of Humanitarian Affairs, Israel restricts or prohibits Palestinian vehicles from using over 400 km of roads serving Israeli settlers in the West Bank (OCHA, 2017c).

Public transport consists mainly of buses, shared private and public taxis and small minivans, both within and between Palestinian localities. In Area C, the Palestinian public transport system is scarcely functional, although Israel maintains its own public bus system connecting settlements with destinations in Israel. The lack of centralized transportation hubs within Palestinian cities means that public transport systems remain limited, and the entire situation of public transport is further hindered due to the lack of a national transportation plan. In addition, the contribution of the transport sector to Palestinian gross domestic product is only 2 per cent (SP, 2018). The ratio of vehicles to inhabitants for inter-city transport is only 1.5/1,000 citizens; within cities, the ratio is 2.2/1,000 citizens (Thawaba, et al., 2017).

Energy network
The West Bank and Gaza Strip rely primarily on Israeli imports to meet electricity needs. In 2015, about 90 per cent of their electricity was supplied by the Israeli Electric Corporation. Israeli Electric Corporation imports represent 99 per cent of consumption in the West Bank, while in Gaza, they represent 64 per cent. Modest amounts of electricity are imported from Jordan into the West Bank and from Egypt into Gaza. The Palestinian Authority has set targets to develop 130 megawatts of renewable energy by 2020 (World Bank, ESMAP and Norway, 2017) .

Approximately 99.7 per cent of localities in the occupied Palestinian territory are connected to the electricity grid. Service, however, tends to be intermittent for nearly all Gaza localities and about one quarter of those in the West Bank. As the occupied Palestinian territory receives about 3,000 hours of sunshine per year, nearly 56 per cent of buildings have solar water heating systems (Census 2017). In early 2016, plans to build solar power plants were announced by the Palestinian Authority, and construction has begun (MoLG, 2016). Energy and fuel costs are currently among the highest in the entire region, due to the near-total dependency on a single country (Israel) as the supplier, with costs estimated at US$0.15 per kWh, making energy increasingly unaffordable for many Palestinians (MoLG, 2016).

Water supply network

Over 90 per cent of Palestinian localities are connected to water supply networks; 34 per cent are dependent on Israeli water sources (MoLG, 2016). In the West Bank, there has been a 50 per cent increase in the population connected to a safe water supply since 1995, with 81 per cent of localities connected and only 7 per cent of households remaining unconnected (Thawaba, et al., 2017). Numerous water issues exist nonetheless, particularly in Gaza, as described in Chapter 7.

Sewage network

Compared with connectivity to water networks, those for wastewater are far less developed. In general, connections to wastewater systems are limited to major urban areas with large populations. Over 70 per cent of Gaza communities are connected to sewage pipes, but the connection rate in the West Bank is only about 15 per cent (MoLG, 2016). Areas that are not served by such networks dispose of their waste through cesspits or directly into the environment (MoLG, 2016). The total percentage of households connected to the sewage network in Gaza is close to 85 per cent, in 24 out of 33 localities (ARIJ, 2015). In the West Bank, only 10 towns are served by sewerage systems, of which only four have treatment plants and none have a reuse scheme. About 85 per cent of West Bank communities still rely on septic tanks and the remaining 15 per cent of communities rely on sewers (Thawaba, et al., 2017).

Solid waste collection and treatment

The Ministry of Local Government supports the Joint Service Councils (JSCs) in delivering solid waste collection and treatment in the West Bank and Gaza Strip. The service of the twelve JSCs covers 83 percent of the total number of Local Government Units in the West Bank, and 74 per cent of the total population. In the West Bank, municipal solid waste generation is estimated at 2,622 tonnes per day, and the per capita generated weight is 0.91 kg/day. Around 65 per cent of municipal waste is collected by the Joint Service Councils, with the remainder under the responsibility of Local Government Units and the United Nations Relief and Works Agency for Palestine Refugees in the Near East. In Gaza, approximately 1,330 tonnes of solid waste are generated per day, which amounts to average per capita production of 0.7 kg/day. There is one Joint Service Council operating in Gaza, in the southern part of the Strip; this Council collects approximately 12 per cent of Gaza's solid waste. (SP, 2019).

According to a 2019 report by Cesvi, the Palestinian population of the occupied Palestinian territory generates approximately 0.9kg/day solid waste per capita, with people in rural areas generating less waste than urban dwellers. The total waste generated per capita increases each year, as a result of population growth and lifestyle changes, although this report notes that in Gaza, despite increase of population, the waste generation rate in decreased in the last two years. Cesvi estimates that Israeli settlements in the West Bank generated about 1,200 tonnes of solid waste per day in 2017, equivalent to 1.9 kg/capita per day (CESVI, 2019).

The major component of solid waste is organic matter (50 per cent), along with cardboard, glass, metals, paper and plastics. Most solid waste comes from major cities. Numerous categories of hazardous and industrial waste are often mixed together, and are then processed with municipal solid waste, along with untreated waste from Israeli settlements (MoLG, 2016).

There are three main landfill sites in the West Bank: Zahrat al Finjan in the northern West Bank, al Minya serving the southern West Bank, and Jericho Sanitary LF covering the Jericho area. In addition to these three, there is a small landfill located in North-West Jerusalem (Beit Anan), and one Israeli landfill (Tovlan in the Jericho area, which takes waste from Israeli settlements) (CESVI, 2019). Approximately 20 per cent of the solid waste generated in the West Bank and Gaza is disposed of in random dumpsites (SP, 2019). According to the Israeli Civil Administration, al Minya treats waste from both Palestinians and Israeli settlements (GoI, 2019). In Gaza, the three sanitary landfills at Deir el Balah, Jahr al Deek and Rafah are currently beyond their operational capacity. The Deir el Balah and Rafah landfill sites were replaced by a new site at Al Fukhari in South Gaza, which became operational in 2019.

Hazardous waste poses challenges to public health and the environment. Although the Environment Quality Authority has made efforts to address this issue, including via the national Solid Waste Management Strategy, "few actions are implemented due to limitations of funds and expertise" (World Bank, 2019). With some exceptions, medical waste is included in municipal

waste, without pre-treatment. Used batteries also constitute environmental and public health hazards, in the West Bank and especially in Gaza (World Bank, 2019).

In addition to the solid waste described above, there is evidence that hazardous products and electronic waste ("e-waste"), is transported from Israel into the West Bank for treatment at numerous waste processing facilities there. Between 2015 and 2018, the Israeli authorities confiscated 164 vehicles that were found to be transporting e-waste and metals from Israel into the West Bank (GoI, 2019). The e-waste business has been documented and analysed by the academics Garb and Davis (Davis G. Y.-M., 2018) and detailed in a B'Tselem report of 2017, which states that "various types of waste: sewage sludge, infectious medical waste, used oils, solvents, metals, electronic waste and batteries" are transported into the West Bank from Israel (Aloni, 2017). Visits by a Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) team to Idhna in Hebron revealed the transfer of metal waste, cars and electronic waste from Israel for recycling (GIZ, 2014); academic analysts have also documented evidence that the West Bank has been subject to the transfer of hazardous wastes from inside Israel in contravention of the Basel Convention (Abde-Qader & Robert-Davis, 2018). A consortium including the North Hebron Chamber of Commerce and CESVI describe e-waste issues in the Hebron area (CESVI et al, 2018). E-waste is addressed below in more detail in section 9.2.

Housing

Challenges facing the housing sector include the expanding population, deterioration of older buildings, the geographically confined situation of Gaza and limitations on new construction imposed by Israel in the West Bank. Between 1988 and 2016, the Israeli authorities issued demolition orders relating to over 16,000 structures (OCHA, 2016).

The total number of housing units was estimated by the Ministry of Public Works and Housing (MoPWH, 2010) at nearly 702,000, with over 456,000 in the West Bank and some 414,500 in Gaza, including closed, vacant and abandoned housing units. The estimated deficit in housing units at that time was 57,300, nearly 33,300 in Gaza and over 24,000 in the West Bank. The same study found that an additional 25,000 housing units need to be replaced in Gaza and some 50,400 need to be replaced in the West Bank. These figures taken together led to the estimate of a combined shortfall and housing renewal need approaching 132,800 in 2010 (Thawaba, et al., 2017). The total housing deficit estimated for 2019 was calculated as some 294,000 units. According to the Ministry of Public Works and Housing (MoPWH, 2017), an additional 359,929 housing units will be needed by 2022 and an estimated 60 per cent of Palestinian families will need new homes within the next decade (MoLG, 2016).

The scope of the housing deficit problem goes beyond a lack of housing units and is also related to cost. "An affordability analysis of the housing market has shown that the units provided are beyond the reach of the majority of the Palestinian families who belong to the low-income and low-middle-income groups." (MoLG, 2016). Adequate, safe and affordable housing remains a key challenge, particularly in areas where the government has limited access. In East Jerusalem alone, a chronic shortage of more than 10,000 housing units exists, and "the lack of housing dramatically increased house prices by 192 per cent between 2007 and 2012" (SP, 2018). For Gaza, the Ministry of Public Works and Housing's 2010 estimate of a lack of 33,000 housing units had more than doubled to 70,000 by 2015, with the blame being placed on "weak urban basic services and infrastructure" that have left many living in debilitated housing conditions and a need for 13,000 extra houses per year to account for the rapidly growing population (SP, 2018).

The destruction caused by previous conflicts has also contributed to the shortage of housing in Gaza. In September 2018, the United Nations reported that "the reconstruction of damages from 2014 is not yet complete. Significantly, while nearly 80 per cent of the 17,800 houses, which were so badly damaged that people could no longer live in them, have now been rebuilt, there is still a funding gap of about US$100 million for the reconstruction of just over 2,500 totally destroyed houses." (UNSCO, 2018) As a result of this damage and delays in reconstruction, 16,500 people remain internally displaced in Gaza.

Palestinians are forced to develop within a very confined space due to the limited availability of land, and the access, zoning and planning restrictions described in Chapters 1, 4 and 10. When these factors are combined with weak policy,

an underdeveloped regulatory and enforcement framework, and outdated land-management and planning systems, land becomes a scarce and very expensive resource.

Green and other community spaces
Limited information is available on urban green spaces or parks. Planning regulations have not been successful in facilitating the provision of public spaces in Palestinian cities, because more consideration is given to building design, elevation, heights, setbacks and parking. Furthermore, no planning policies are currently mainstreamed within the Palestinian spatial planning systems that design, manage, implement and maintain public spaces in cities and towns (MoLG, 2016). Green spaces also remain minimal, due in part to urban expansion.

9.2 Pressures and impacts

The pressures affecting Palestinian urban areas are mainly related to demographic trends, financial issues, governance and legal regimes, informal and unplanned urban growth, aging infrastructure, and waste generation and disposal. Additional challenges are posed by the isolation of Gaza, and the fragmentation of land in the West Bank. The lack of available land, rapid urban population growth, the unstable political situation, fragmented urban development in the West Bank, and the diffusion of urban sprawl within the landscape and around cities are major challenges (Moghayer, Tesmamma, & Xinping, 2017).

The following paragraphs cover these challenges and their impacts.

Demographic trends and the need for additional urban space and affordable housing: Population growth (described in Chapter 3) is putting tremendous pressure on urban areas.

Financial issues: While the local government sector is one of the major recipients of international development assistance, this sector faces constrained financing due to an unstable rate of revenue collection, a complex internal system of revenue distribution between the various branches of national and local government, the lack of territorial contiguity between the West Bank and the Gaza Strip, the current political impasse and a weak national economy. This situation is exacerbated by a highly restrictive spatial economic planning regime, and continuing closure of the Gaza Strip (MoLG, 2016).

Unreformed and inconsistent governance and legal regimes: Administrative and governmental systems remain heavily influenced by various laws and by-laws that were inherited from previous administrative regimes (Ottoman Turks 1516–1917, British Mandate 1918–1948, Jordanian administration 1948–1967, Israel 1967–1993 and Palestinian Authority 1993 to present) (MoLG, 2016). According to the Palestinian Ministry for Local Government, former rulers employed highly centralized power structures and mechanisms for decision-making (MoLG, 2016). Another basic problem of urban governance is that "mobility and transport planning and policies in Palestine are highly fragmented, and the majority of sectoral plans for traffic and infrastructure networks are not aligned among the different administrative units, be it in the relevant ministries or the local government units" (MoLG, 2016).

Informal and unplanned urban growth: Informal and unplanned growth presents a challenge, particularly in cities and larger towns. The high urban growth rate is accompanied by random spatial development, as cities and communities have expanded haphazardly, encroached on surrounding agricultural land and now suffer from poor infrastructure (El-Atrash, 2017). The "political situation has played a major role in the degradation of landscapes, cultural and historical sites... The spread of uncontrolled and fragmented urban developments within and around the cities has impacted negatively the urban form" (Moghayer, Tesmamma, & Xinping, 2017). There is, furthermore, no zoning or planning regime for refugee camps, which – also in the context of severe overcrowding in some camps – has contributed to unauthorized "vertical" construction (UNRWA, 2019a).

An ageing and limited Infrastructure Housing: Aside from the lack of housing units and deteriorating housing conditions described above, the administrative difficulties of obtaining permission to build new houses in Area C of the West Bank and East Jerusalem have major negative impacts on Palestinian housing. For example, in Area C and East Jerusalem, Israeli authorities routinely refuse to grant construction licenses to Palestinians. In East Jerusalem alone,

over 10,000 housing units are required to meet immediate demand (MoLG, 2016). Moreover, even though Palestinian natural growth in East Jerusalem would require the construction of an additional 1,500 housing units per year, only an average of 400 new housing units per year are authorized by the Jerusalem Municipality. In Area C, less than 1 per cent of the land has been planned for Palestinian development. Over 16,000 demolition orders were issued in Area C between 1988 and 2016 (OCHA, 2017b). In 2019, 365 Palestinian-owned structures were demolished: this represents a 38 per cent increase compared with 264 in 2017, and a 36 per cent increase compared with 268 in 2018. In East Jerusalem, 194 structures were demolished in 2019, representing a 13 per cent increase compared with 2018 (United Nations, 2019).

Transport systems and roads: The occupied Palestinian territory lacks air and rail transport systems and a modern mass transport fleet for passengers. These limitations affect local Palestinian communities in terms of social disintegration, environmental degradation, public health deterioration and pressure on land (MoLG, 2016). In addition, Palestinian cities and towns suffer from connectivity challenges, as manifested in the traffic congestion. Furthermore, mobility constraints exist between various urban areas, and between urban and rural communities. This is mainly a result of the fragmentation of the West Bank. A general lack of resources for land acquisition and infrastructure upgrades has resulted in outdated road networks and transport modalities, the absence of major infrastructure interventions (i.e. building of tunnels, bridges, bypass roads, etc.) and the absence of sustainable mobility solutions (i.e. city buses, trams, cycling routes, etc.) (MoLG, 2016).

Waste generation and disposal: Communities, municipalities and village councils struggle to cover the costs of waste collection, transportation and disposal. Only around 1 per cent of waste generated within the occupied Palestinian territory is recovered and recycled today, although this should increase to 30 per cent in 2022 with the implementation of the National Strategy for Solid Waste Management in Palestine (MOLG, 2019). Solid waste management in Gaza faces numerous challenges, including "the lack of investment in environmental systems, the tendency of giving less attention to environmental projects, the absence of related law enforcement, and the tendency of resorting to crisis management rather than prevention", and the huge quantities of rubble and debris that have been generated by conflicts since 2000 (MoLG, 2016).

The United Nations Relief and Works Agency for Palestine Refugees in the Near East has a Solid Waste Management framework for refugee camps under the mandate of the Infrastructure and Camp Improvement Programme. There are nonetheless numerous challenges relating to solid waste management in the camps, including unauthorized use of the Agency's peripheral containers and informal waste accumulations. According to the United Nations Relief and Works Agency, "technical, economic and social aspects along the service chain – solid waste generation and composition, storage at source, collection and removal, and occupation health and safety for solid waste management operators – make the quality of the service limited, and refugees unsatisfied". (UNRWA, 2017). The challenges are heightened by high population density in all the camps. The city of Bethlehem, for example, includes or is adjacent to three refugee camps: 'Azza, established in 1950, with 2,801 inhabitants; Aïda, established in 1950, with 6,545 inhabitants; and Dheisheh, located adjacent to the municipal boundaries, established in 1949 with 17,503 inhabitants.

Solid waste in northern Gaza, February 2019. (UNEP, 2019)

The estimated population density of Dheisheh nears 51,615 inhabitants per km2, or roughly twice the population density of Paris (UNRWA, 2019b). In 2018, 47,225 tonnes of solid waste was brought to the landfill from the camps (UNRWA, 2019b).

The World Bank supported the development of the Zahrat al Finjan sanitary landfill in the Jenin area. The landfill was designed to serve the entire northern West Bank, as well as temporarily handling waste matter from Ramallah and Al-Bireh cities in the central West Bank, whose dump sites were ordered closed. The sanitary landfill was "the first of its kind in the Middle East, equipped… with an automated billing and weighing bridge" (World Bank 2016).

According to a Cesvi report published in 2019, Zahrat al Finjan landfill had reached almost its full capacity in 2018. Al Minya sanitary landfill was designed originally for 630 tonnes/day, but in November 2018 it was receiving 1,100 tonnes/day: all the waste from the southern governorates, Bethlehem (220t/day) and Hebron (700 t/day), as well as from East Jerusalem (115 t/day) and settlements (65t/day). At Al Minya, "Leachate management is an issue, as the only method to reduce it is evaporation. There is a treatment unit with an aeration tank, which is out of order; an odour repellent is sprayed regularly on the leachate ponds and over the landfill itself, in order to limit the inconvenience to nearby residents. The ponds face the risk of overflow during certain seasons and the reduction of the leachate is very low." The Jericho landfill was due to be full "by mid-2019 and there are currently no possibilities for further expansion". Plans for a new landfill in Area C in Rammun area were reportedly on hold, apparently due to opposition from local residents (CESVI, 2019).

Random dumping is practiced in the occupied Palestinian territory, especially of construction and demolition debris, used tyres or agricultural waste. According to Cesvi, "It is difficult to have an up-to-date list of all the uncontrolled dumpsites. In the last few years, thanks to the opening of sanitary landfills and several rehabilitation efforts, many illegal dumpsites could be closed." (CESVI, 2019). In 2019, an estimated 343 tonnes/day in the West Bank and 443 tonnes/day in the Gaza Strip are disposed in dumpsites (CESVI, 2019) (MoLG-JICA, 2019).

Recycling of e-waste: Solid waste products impact on the local environment. Specialized Israeli firms operating in the West Bank include the EMS Refiners of Precious Metals in the Shilo Industrial Zone and All Waste in the Barkan Industrial Zone. Small Palestinian recycling businesses are also involved (Aloni, 2017). While informal e-waste processing is dispersed across the West Bank, the overwhelming majority takes place in the rural villages of southwest Hebron. With a population of 35,000 within a 40 km2 area, these villages are collectively known as the "West Line" and are recognized as a "scrap capital" (Davis & Garb, 2019).

The West Line cluster of scrap-processing villages emerged through a mixture of structural and chance circumstances: proximity to Israel, a history of importing Israeli used products and proportionally higher levels of unemployment following the second Intifada, provided the opportunity and motivation for importing e-waste. The amount of e-waste received and processed in these Palestinian villages is estimated at between 57,000 to 64,000 tonnes annually (156–175 tonnes per day). The processing of this waste is mainly carried out by workers who pick through piles of e-waste, item-by-item, dismantling products into critical fractions (e.g. copper, aluminum, iron, etc.) using "smash and separate" tactics (Davis & Garb, 2019). The young men that are contracted by scrap yard owners to burn their cables often allow minors to assist them in burning the cables, in exchange for access to pick through the ashes to collect copper remains after the burn is complete (Davis & Garb, 2015).

This informal and largely unregulated industry supports an estimated 380 businesses, 1,000 full-time jobs, and generates over US$28.5 million per year, yielding a significant source of local income, in a region in which other sources of employment are scarce (Davis & Garb, 2019). About 80 per cent of households in this area are involved either directly or indirectly in processing e-waste to extract copper and other valuable metals. Metals recovered from e-waste are one of the largest Palestinian exports to Israel (Davis & Garb, 2018). Waste processing is, therefore, an important source of income for communities in the Hebron area.

A large volume of solid waste is dumped in open, uncontrolled, and unmonitored sites and burning

is the standard practice used for waste volume reduction in these dumpsites. Dispersed burn sites generate multiple sources of contamination. The Israeli Civil Administration notes that "smoke from burning cables, which includes smoke from plastics and rubber, contains significant amounts of carcinogens. Runoff from the area contains soluble substances from the waste, as well as solid particles, heavy metals, and various pollutants which enter into the local soil and aquifers. This pollution is also harmful to local flora and fauna, and is detrimental to the health of both Israeli and Palestinian residents" (GoI, 2019).

The serious downside of the illegal dumping and treatment of e-waste can be seen in the village of Idhna, where e-waste workshops are located in residential areas, next to households and schools. This has led to both environmental hazards and health problems for residents who are exposed to harmful materials and risk injury in the workshops. When active, burning sites release toxic black smoke that lingers for several hours, with the chemicals released including benzene, dioxins, mercury and polychlorinated biphenyls (ARIJ, 2015). This pollution can be blown by the wind for some distance and adversely impact human health (ARIJ, 2015). E-waste also contains substances that can be directly toxic upon release: "In particular, heavy metals and organic compounds such as dioxins, furans, and brominated flame retardants can negatively affect the environment and human health if they are not disposed of properly (Brigden et al., 2005; Gullett et al., 2007;Li et al., 2006; Wu et al., 2008), entering the food chain and creating long-lasting effects even after initial exposures have subsided (Bellinger et al., 1992, 1994; Ciesielski et al., 2012)." (Davis & Garb, 2018).

Evidence is emerging of health impacts on the local community. For example, research published in the International Journal of Cancer identified a strong spatial association between e-waste burn sites and childhood lymphoma in the rural West Bank (Davis & Garb, 2018). Finally, there is the thriving cross-border business of transferring and dismantling old vehicles and extracting their usable parts for recycling. The existence of dozens of these so-called "chop shops" throughout the West Bank, often on the edge of urban areas such as Hebron, constitutes another source of pollution for the soil, surface and groundwaters (Davis & Garb, 2018).

Other impacts of conflict/occupation for urban areas

The separation barrier: In 2002, the Government of Israel approved construction of a separation barrier in and around the West Bank with the stated purpose of preventing violent attacks by Palestinians in Israel. Land for construction of separation barrier sections inside the West Bank has been requisitioned from Palestinian landowners. Approximately 85 per cent of the projected 712-kilometre-long structure runs inside the West Bank (OCHA, 2019).

The limited allocation of permits, combined with the restricted number and opening times of the barrier gates, impedes essential year-round agricultural activities such as ploughing, pruning, fertilizing, and pest and weed management. As a result, there is an adverse impact on olive productivity and value. Data collected by the United Nations Office for the Coordination of Humanitarian Affairs in the northern West Bank show that the yield of olive trees in the area between the separation barrier and the Green Line has reduced by approximately 65 per cent in comparison with equivalent trees in areas accessible all year round (OCHA, 2017a).

According to the Ministry of Local Government, the separation barrier "has resulted in direct and indirect forms of displacement of people who left their communities seeking security and new sources of livelihood in the jobs and services offered by urban areas and cities" (MoLG, 2016). It has also impacted on the freedom of movement, accessibility and socioeconomic development of contiguous and nearby Palestinian rural communities (MoLG, 2016). This has a direct impact on the potential development of Palestinian urban areas, since "the land available for future spatial development is also limited. For example, within the 'seam zone' [between the separation barrier and the Green Line] less than one third of the area is available for development, while half consists of agricultural land and greenery, 25 per cent each." The barrier thus affects "Palestinian spatiality and communities, while *de facto* annexing space and natural resources" (MoLG, 2016).

Beyond the impacts of the separation barrier on urbanization, land fragmentation in the West Bank more generally causes challenges for urban

development and Palestinian construction plans. As reported above, the Quartet assessed in 2016 that "Some 70 per cent of Area C has been unilaterally taken for exclusive Israeli use, mostly through inclusion in the boundaries of local and regional settlement councils or designations of 'state land'. Nearly all of the remaining 30 per cent of Area C, much of which is private Palestinian property, is effectively off-limits for Palestinian development because it requires permits from the Israeli military authorities that are almost never granted." (United Nations, 2016).

The boundaries outlined for Areas A and B impose an artificial scarcity of land for some communities. This situation contributes to the difficulty in obtaining lots for construction, high prices for the few available plots, the dearth of open areas and the lack of suitable sites for infrastructure and industrial zones. If residents of these areas do build homes without permits on nearby land, owned by them but classified as 'Area C', they risk demolition (Kadman, 2013).

Impacts on the urban structure in Gaza: Numerous conflicts in Gaza have taken their toll on urban areas and their infrastructure. Following the 2008–2009 conflict, a United Nations report found that "homes and public infrastructure throughout the Gaza Strip sustained extensive damage. Gaza City was the worst-hit". The most obvious impact from the recurrent hostilities is the large quantity of demolition debris that has been generated, with satellite imagery showing that 2,692 buildings were impacted. Some of these buildings were completely destroyed, while others were partially damaged and rendered unsafe. The United Nations Development Programme estimates that the total quantity of demolition debris produced during this period was close to 600,000 tonnes (UNEP, 2009).

Aside from buildings and housing, other infrastructure in Gaza has also been affected by the conflicts. In the case of the 2008–2009 hostilities, again there was "serious damage created by the breakage of the embankment at Az Zaitoun water treatment facility, and other parts of the water supply and sewage system were affected during the hostilities. This includes impacts to water wells, the water distribution network, sewage collection network and water tanks" (UNEP, 2009). Other conflicts since 2000 have also had major impacts on Gaza. Following the 2014 conflict, a UNDP assessment found that a total of 20,000 metres of water network pipes and 15,000 metres of sewage networks and carrier lines were damaged; 12 sewage pumping stations were partially damaged; two desalination units were totally destroyed and four were partially damaged; and three wastewater treatment plants underwent partial damages. This assessment also described severe damage to water and sanitation infrastructure at the household level, and damage to over 13 per cent of the housing stock (UNDP, 2014).

Impacts of Israeli settlements in the West Bank: According to the Middle East Quartet, since the beginning of the Oslo process in 1993, the population of settlements has more than doubled, with a threefold increase in Area C alone. There are now some 130 settlements located in Area C (United Nations, 2016). As noted above, the settler population generates more solid waste per capita than the Palestinian population, and solid waste from settlements contributes to the strain on West Bank solid waste management capabilities. Settlements and related Israeli bypass roads (which are generally inaccessible to Palestinians) have a deep impact on Palestinian access, movement and urban development.

Impacts of Israeli industry
Eleven Israeli industrial complexes are located in Area C of the West Bank, often near Palestinian towns and villages. According to Israeli figures, these complexes include 668 facilities and employ over 11,000 people (GoI, 2019). The Gishori Industrial Complex is located on the eastern side of the Green Line, between Tulkarem and the Israeli village of Nitzanei Oz, within a few hundred metres of the Palestine Technical University Kadoorie. Scientific studies have demonstrated that soil near the Gishori Industrial Complex is polluted with nickel, lead and zinc (Natsheh, 2016), and that soil pollution impacts plant diversity in the Tulkarem area (Al Khalil, 2019). Such pollution may be linked to the production of agrochemicals in Gishori Industrial Complex, although it is possible that soil pollution is derived from other sources in this area.

9.4 Responses

Institutional framework for the urban environment
Three levels of government are responsible for Palestinian urban issues: national, regional and local. In terms of urban planning, for example, the planning system follows a top-down, hierarchical

approach. There are three levels of spatial planning as mandated by the Ministry of Local Government, and these are "represented by the higher planning council, district planning committees and local planning committees" (MoLG, 2016).

At the local level, there are 430 entities, or 146 municipalities and 284 village councils, designated as local government units that play a key role in policy planning and implementation at the local level. There are also more than 93 joint service councils, in which two or more local governmental units cooperate in exercising their council functions (e.g. planning and development) or in the provision of services (e.g. solid waste collection and water distribution) (MoLG, 2016).

The Local Authorities Law of 1997 specifies the functions of the local government units. These include a total of 27 responsibilities: "town and street planning, building and construction permits, provision and management of water, power, wastewater treatment, solid waste disposal solutions, as well as organizing and monitoring public markets, industrial zones, public facilities and public spaces, emergency preparedness and response plans, road and traffic management, and the management of local public health, among others". However, in light of the general fiscal and economic situation, the financial resources of the local government units are scarce and unstable. They experience "significant budget deficits, and most of the time they are unable to cover their operational expenditures and deliver essential services". The majority of Palestinian local government units deliver less than half of the services they are mandated to provide (MoLG, 2016).

Another challenge to urban governance is the overlap, especially at the national level, between different ministries, such as the Ministries of Education, Health, Transport and Communication, Finance and Planning, Economy, Tourism and Antiquities, and the Environment Quality Authority in terms of spatial planning mandates, functions and responsibilities for Palestinian cities (MoLG, 2016).

Israel applies its own legal frameworks and regulations to Israeli industrial zones that are located in Area C. According to the Israeli Civil Administration, industries located in Israeli settlements are subject to environmental laws within the "Local Council Regulations" framework that were adapted to Israeli legislation. The Israeli Business Licensing Law applies to the industrial zones, and they are required to comply with laws and regulations of industrial zones in Israel (GoI, 2019).In settlements, some Israeli legislation relevant to the environment is not applied, however. Details are provided in Chapter 12 below.

Policy measures and land use planning

Two sets of planning legislation were applied prior to 1967: the Jordanian Law of 1966, applicable in the West Bank including East Jerusalem; and the Town Planning Ordinance of 1936 for Gaza. Despite numerous attempts at a national level to prepare a unified and updated planning law (Planning and Building Act), this has not been achieved to date. As a result, "outdated legislation continues to govern the planning system in Palestine today" (MoLG, 2016). While urban development plans have often been prepared for various localities, these "have remained on paper, due to different reasons that include mainly financial incapacities and the outdated regulatory framework in place. Only very few of these plans have been successfully mainstreamed into the planning system" (MoLG, 2016). In general, future efforts to develop a unified planning approach for Palestinian cities and towns need to focus more on integrated urban planning, as opposed to the past practice of "statutory planning" (MoLG, 2016).

Policy measures related to service utilities

Regulation of utilities (water, sanitation and electricity) is performed by the Ministry of Local Government, the Palestinian Water Authority, the Environment Quality Authority and the Palestinian Energy and Natural Resources Authority. Collectively these four government entities, along with the local government units and regional water bodies, are mandated to ensure that all Palestinians in Gaza and the West Bank receive an adequate supply of freshwater and electricity, that solid waste and wastewater are collected and properly disposed of, and that existing infrastructure is properly maintained.

A series of laws dating from the mid-1990s established the basic legal framework for handling solid waste across the occupied Palestinian territory, including the Environmental Law of 1999 that covered sanitary landfills, prohibited the burning of solid waste and encouraged reuse and recycling measures. The Public Health Law (no.

20) of 2004 and the Medical Waste Management bylaw of 2012 attempted to regulate hazardous and medical waste respectively. Finally, the National Strategy for Solid Waste Management (NSSWM; 2010–2014) aimed to establish the path of development in this sector until at least 2014 (ARIJ, 2015).

Implementation and enforcement of solid waste-related measures are deficient, due to insufficiency of the legislation itself, weak enforcement of laws and loopholes in the current laws that result in ambiguity in institutional frameworks, and the overlap and conflict in the solid waste management duties of several institutions. Regulations, instructions, specifications and norms for waste management are within the scope of the Environment Quality Authority, and could be developed in collaboration with relevant institutes such as the Ministry of Health and the Palestinian Standards Institute. Additionally, the overlap and conflict in the solid waste management duties of several institutions may also hamper efforts in developing an effective and organizational framework for solid waste management (ARIJ, 2015), (CESVI, 2019).

According to the Israeli Civil Administration, in response to the problems at al Minya described above, the landfill "owners and the Environmental Unit of the Civil Administration, are trying to promote a solution for the site using new recycling technology". The Civil Administration has reportedly offered field visits "to show the Palestinian side possible recycling solutions, and discuss ways to work together to find solutions for the Al-Menia facility" (GoI, 2019).

The Israeli Civil Administration forbids transporting of solid waste from Israel to the West Bank. There is, however, "a special authorization, by the Environmental Unit in the Civil Administration, to transport solid waste from Israel to the West Bank, and to monitor and inspect the transportation of solid waste". Permits by the Coordinator of Government Activities in the Territories are issued physically in the offices of the Civil Administration, and "are not issued to domestic or industrial waste from Israel". According to the Israeli authorities, most of these permits are provided for the "transportation of excavated material (not construction waste) to the Al-Ram quarries as part of the management of construction works in the area of Jerusalem and as a solution to the rehabilitation of those quarries. Furthermore, permits are given for specific solid waste transportation to some factories in the West Bank specialized in various recycling and waste treatment services (e.g. SAFA factory in Idhna for e-waste, Compost Or/Masoa in the Jordan Valley, etc.)" (GoI, 2019).

The Israeli Civil Administration reports that it is closing and remediating illegal dump sites, and that it has established systems to control the unauthorized transportation of waste from Israel into the West Bank. The Coordinator of Government Activities in the Territories' Environmental Unit contains a team of 12 inspectors ("The David Unit") that are stationed in the main checkpoints between Israel and the West Bank to ensure that only authorized vehicles enter the West Bank, and according to the conditions detailed in the permits. According to the Coordinator of Government Activities in the Territories, "unauthorized vehicles that break the law are (usually temporarily) confiscated and the Israeli company/driver are subject to hearing procedure in the Civil Administration." Furthermore, "a network of cameras in some of the checkpoints helps the Environmental Unit to monitor the waste vehicles. This network is synchronized with the mentioned above system". The Israeli authorities report that during four years of activity, the David Unit has confiscated approximately 1,000 vehicles, carrying different types of waste (GoI, 2019). Of the illegal waste confiscated from unauthorized trucks by the Coordinator of Government Activities in the Territories in 2018, 24 per cent was metals and e-waste, and 29 per cent was construction waste. Israel also reports that in 2018–2019, the Israeli Civil Administration District Office undertook enforcement measures against 10 companies and four local authorities, in areas including illegal wastewater discharge, improper treatment of waste, soil pollution by hazardous waste (oils and fuels), air pollution, illegal/improper storage of chemicals and improper treatment of asbestos.

Despite these control measures, the processing of e-waste, along with other hazardous waste products, continues to cause serious pollution. The Israeli Civil Administration states that as of February 2019 "the sole body with a permit to enter electronic waste into Judea and Samaria is Safa Recycling": this is a Palestinian-owned company that operates a facility for mechanical separation of metals in cables, as an alternative to burning.

However, "despite the David Unit carrying out inspections at checkpoints, there is still smuggling of waste" from Israel into the West Bank. The Israeli Civil Administration reports that it continues to search for solutions. (GoI, 2019).

Some donors have investigated options to support the development of a sustainable Palestinian recycling sector. In 2018, a pilot project funded by Sweden designed to regulate the e-waste recycling industry while addressing its serious environmental effects (Garb, 2017) contributed to a significant reduction in complaints to the Israeli Civil Administration about smoke from cable burning (GoI, 2019). This project has, however, been discontinued since the design of its extension and scale-up could not be agreed. Another three-year project on the promotion of sustainable growth in Palestine through an environmentally safe, innovative and economically valuable treatment of waste from electrical and electronic equipment started in 2017 and is ongoing. This is funded by the European Union and implemented by the North Hebron Chamber of Commerce and Industry, Cesvi and Green Land Society for Health Development. The initiative aims at supporting formalization of informal recyclers, supporting dialogue with public authority, introducing environmentally sound technology, improving occupational health and safety, and economic performances. Officials involved in this initiative claim that the number of workshops and burn sites has been reduced, although estimations are difficult due to the fluctuating numbers and informal nature of the sector. In addition, there has also been some discussion around extended producer responsibility laws for the purpose of e-waste rationalization (Davis & Garb, 2019).

International cooperation, the New Urban Agenda and Sustainable Development Goals

The State of Palestine has endorsed the 2030 Agenda for Sustainable Development in September 2015, including Sustainable Development Goal 11 of making cities and human settlements inclusive, safe, resilient and sustainable. In doing so, the State of Palestine voluntarily recognized urbanization and city growth as a transformative force for development (El-Atrash, 2017). The Palestinian government is committed to working with local and international partners to realize the Sustainable Development Goals (SP, 2018).

This official enthusiasm is tempered, however, by the realization that "thinking urban, in terms of potentials, limitations and ways in which global and regional urban agendas and urbanization trends are impacting national and local urban development plans, is still a new concept and at best a work in progress" (MoLG, 2016). Beyond Goal 11 in terms of urban environmental governance, the New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador on 20 October 2016, and was endorsed by the United Nations General Assembly in December 2016. The New Urban Agenda "represents a shared vision for a better and more sustainable future... urbanization can be a powerful tool for sustainable development for both developing and developed countries" (United Nations, 2017). The Government of the State of Palestine joined the New Urban Agenda, thus agreeing to work towards more sustainable cities (El-Atrash, 2017).

9.5 Conclusion and suggested actions

The Palestinian Authority's stated goal of "making cities safe, resilient and sustainable" is of central importance (MoLG, 2016). However, bringing about real and sustainable change in, and improvements to, the Palestinian urban fabric remains challenging under current circumstances.

While Sustainable Development Goal 11 on sustainable cities and the New Urban Agenda both offer signposts for the future, (El-Atrash, 2017) new thinking is needed to chart a way forward. Concepts such as integrated city development practices "are much needed to help identify priority action needs and to develop socioeconomic agendas with spatial relevance, as these cannot usually be addressed adequately by traditional physical or land-use planning that is considered outdated in current practice" (MoLG, 2016). In addition, new approaches to various environmental issues that are inevitably transboundary in nature, and which both stem from and negatively affect urban areas, need to be considered.

Suggested actions to address the challenges relating to the urban environment include:

Urban development (city planning)

- Undertake an integral, city-wide approach to urban development, introducing new tools and concepts such as compact

communities, 'smart' urban growth, scenarios and modelling techniques, with the aim of achieving sustainable urban growth both from an environmental and a socioeconomic perspective; and
- Where possible, introduce public-private partnerships to help upgrade areas of informal urbanization and regenerate the core of old cities as economic magnets/"urban multipliers".

Housing shortage
- Invest in infrastructure and upgraded public services for areas beyond the urban core, to allow greater decentralization and more reasonable housing prices, helping to bridge the housing gap and bring more, and more affordable, housing units onto the market;
- Offer financial incentives such as low-cost loans to communities and individuals, encouraging them to rehabilitate older buildings and housing units that are still fundamentally viable; and
- Improve existing frameworks for land registration.

Urban development (infrastructure)
- Develop modern, reliable public transport systems to ease urban crowding, pollution and traffic problems, both within cities and between cities and major towns and villages;
- Invest in additional and improved public spaces, particularly green spaces and parks, as an environmental dividend and haven for the highly urbanized Palestinian population; and
- Upgrade current utility systems (electricity, sanitation and water) to assure regular and reliable supplies of power, potable water and sewage removal for improved human health. These should include renewable energy sources (solar and wind) and cooperation with Israel on development of further decentralized, small-scale desalination facilities.

Solid waste management, including transboundary waste
- Introduce the principles of extended producer responsibility for transboundary waste issues of all types, and explore "win-win" solutions to address issues relating to e-waste, in line *inter alia* with commitments made under the Minamata Convention;
- Improve standards and environmental operational guidelines for sanitary landfills and transfer stations, including review and amendment of the by-law on solid waste management;
- Conduct inventories on both e-waste and on construction and demolition waste, and develop appropriate legislation and enforcement mechanisms for dealing with these waste flows; and
- Invest in strategies and programmes for the recycling and composting of solid waste, with the twin goals of reducing volumes of solid waste and partially recovering costs.

Monitoring urban progress
- Apply appropriate tools to monitor implementation of the above proposals, and report on a regular basis to the Palestinian public on progress. One potentially useful system available since 2012 is the City Prosperity Index from UN-Habitat, which offers the possibility to measure sustainability at the urban level.

Together, these actions would offer multiple pathways for better coping with the current situation in the occupied Palestinian territory.

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Chapter 10: Land degradation and soil contamination

10.1 Introduction

Target 15.3 of the Sustainable Development Goals sets out a global ambition: to achieve a land degradation neutral world by the year 2030. The United Nations Convention to Combat Desertification defines land degradation neutrality as “a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems”. The focus is on maintaining or enhancing the natural land resource base; in other words, the stocks of natural capital associated with land resources and the ecosystem services that flow from them. In order to quantify the Goal indicator 15.3.1 – the “Proportion of land that is degraded over total land area” – three sub-indicators are utilized to derive the spatial extent and thus the percentage of total land that is degraded. These are: land cover, land productivity and carbon stocks, above and below ground.

These land-based indicators and associated metrics, i.e. land cover (assessed as land cover change), land productivity (assessed as net primary productivity) and carbon stocks (assessed as soil organic carbon), have been adopted by the United Nations Convention to Combat Desertification as a minimum set of globally agreed indicators and metrics, for reporting and as a means to understanding the status of degradation. Such indicators could be used for monitoring and reporting progress towards target 15.3.1 as well as other relevant targets and commitments. Land cover provides the first indication of a reduction or an increase in vegetation, habitat fragmentation and land conversion. Land productivity offers an indication of ecosystem health and sharpens the focus on ecosystem services (UNCCD, 2016).

10.2 Status and trends of land degradation

Land cover and land-use change is necessary for the future management of the environment. The area under different cover types for the occupied Palestinian territory, as estimated by the Food and Agriculture Organizations of the United Nations is shown in table 28. Between 1992 and 2015, the area under artificial surfaces has dramatically increased from 1.4 per cent to 4.3 per cent,

whereas the area under vegetation cover has been decreasing.

Currently about 17 per cent of land in the West Bank is planted with olive trees, and this provides critical jobs and income from the processing of olives (World Bank, 2019).

The small increase in grassland and tree-covered areas in the occupied Palestinian territory can be attributed to the Greening Palestine Programme, which the Ministry of Agriculture has been implementing in cooperation with other actors. The programme involves distributing and planting hundreds of thousands of trees each year (fruit trees, forestation and drought tolerant grazing shrubs) throughout the West Bank. In addition, there has been an increase in the use of the drought-tolerant fodder crops in the rangeland, such as barley, vetch and common vetch.

Olive farming in the West Bank. (OCHA, 2017)

Table 28: Landcover area (1,000 Ha) and percentage of occupied Palestinian territory total area, 1992, 2015 (FAO, 2019b)

Land cover	1992		2015		Change	Change per year
	Value	%	Value	%	Value	Value
Artificial surfaces (including urban and associated areas)	8.14	1.4	25.77	4.3	+17.63	+0.77
Grassland	41.32	6.9	42.46	7.1	+1.14	+0.05
Herbaceous crops	108.69	18.1	94.64	15.7	-14.05	-0.61
Shrub-covered areas	39.50	6.6	38.46	6.4	-1.04	0
Sparsely natural vegetated areas	121.27	20.1	117.20	19.5	-4.07	-0.05
Terrestrial barren land	121.82	20.2	116.66	19.4	-5.16	-0.22
Tree-covered areas	40.03	6.6	42.59	7.1	+2.56	+0.11
Woody crops	121.23	20.1	124.21	20.6	+2.98	+0.13
Total land area	~602					

Table 29: Land use area (1,000 ha) and percentage of occupied Palestinian territory total area, 1992 and 2015 (FAO, 2019b)

Land use	1992		2015		Change	Change per year
	Area	%	Area	%	Area	Area
Agricultural land	370.0	61.5	296.9	49.3	-73.1	-3.18
Forest land	9.1	1.5	9.2	1.5	+0.1	0
Other lands	222.0	36.9	295.9	49.0	+73.9	+3.18
Total land area	~602					

Table 30: Trend in occupied Palestinian territory agricultural areas, 1997, 2015–2016 (FAO, 2019a)

Attribute	1997	2015-2016	Change	Change per year
The total area of the country (1,000 ha)	602	602 (2016)	0	0
Arable land area (1,000 ha)	105	50.82 (2016)	-54.18	-2.85
Permanent crops area (1,000 ha)	115	96.1 (2016)	-18.90	-0.99
Cultivated area (arable land + permanent crops) (1,000 ha)	220	146.9 (2016)	-73.10	-3.85
Percent of total country area cultivated	36.54	24.4 (2016)	-12.14	-0.64

Numbers in () indicate the year of the estimate.

Table 29 shows the changes in the types of land use in the occupied Palestinian territory over time. From 1992 to 2015, the area under agriculture decreased from 61.5 per cent to 49 per cent while other land uses increased. Forest land, which comprises a relatively small area, remained about the same.

While the Palestinian population has grown from 2.9 million in 1997 to 4.8 million in 2016, the percentage of area under cultivation has decreased from 36.54 per cent to 24.4 per cent over the same period.

Land productivity
Land productivity refers to the total above-ground net primary productivity defined as the energy fixed by plants minus their respiration. To date, no scientific assessment of net primary productivity of the occupied Palestinian territory has been carried out.

Carbon stock
Carbon stock is the quantity of carbon in a pool (i.e. a system which can accumulate or release carbon). Terrestrial carbon pools are biomass (above-ground biomass and below-ground biomass), dead organic matter (deadwood and litter) and soil (soil organic matter).

Soil organic carbon is an indicator of overall soil quality associated with nutrient cycling and supply, water holding capacity, and soil aggregation stability and structure. Soil organic carbon stocks are therefore of local importance, but also of global importance because of their role in the global carbon cycle. The soil organic carbon pool can be both a source and a sink of carbon and is thus fundamental to the estimation of carbon fluxes. Soil organic carbon stocks are largely influenced by anthropogenic activities such as land-use change and management practices, which affect the productive potential of the soil. A reliable estimate of this indicator is not available for the occupied Palestinian territory. However, between 1990 and 2016 the carbon stock in living forest biomass in the occupied Palestinian territory increased from 0.48 million tonnes to 0.58 million tonnes (FAO, 2019b).

Pressure and impacts on land and soil

Area C of the West Bank includes valuable grazing and agricultural land, and water resources. Israel's continued control over Area C and the restrictions it imposes on Palestinian use of land and resources in Area C have significant effects on Palestinian land use.

In a 2009 report, the United Nations Office for the Coordination of Humanitarian Affairs documented the planning and zoning regime applied by Israel in Area C of the West Bank. According to United Nations Office for the Coordination of Humanitarian Affairs, some "39 per cent of the West Bank falls under the jurisdiction of Israeli local or regional councils, the local authorities that run the settlements. This area is almost 40 times more than the territory taken up by the built-up area of settlements and five times more than the municipal area" (OCHA, 2009). A military order issued after the Interim Agreement declared the municipal areas of settlements as closed military zones for Palestinians, into which a Palestinian may not enter without a permit (OCHA, 2009).

In addition to settlements, Israel has designated approximately 18 per cent of the West Bank as a closed military zone. Palestinian access to these areas is prohibited, although enforcement of the access restrictions varies, and the exact boundaries of the closed area are not demarcated on the ground. Furthermore, approximately 10 per cent of the West Bank is an Israeli-designated nature reserve (of land designated as a nature reserve, some 48 per cent overlaps with the closed military training zones) (OCHA, 2009). Palestinian access to the area around the separation barrier, and between the barrier and the Green Line (the "seam zone"), is also restricted. While many of these restricted land categories overlap with one another, accounting for overlaps, "the net amount of territory covered by the categories listed above represents some 44 per cent of [the entire] West Bank territory" (OCHA, 2009). Settlements have expanded since 2009, so the amount of land to which Palestinian access is restricted may now be higher than it was a decade ago.

Because Palestinians have, in effect, been prevented from using a large proportion of the West Bank, they use the remaining available land areas intensively. In Areas A and B, rapid urbanization has led to construction over areas of fertile land: for example, the plains of Jenin, Tulkarm, and Qalqiliya have been converted from agricultural lands to urban areas, with the consequent loss of citrus farms and open agricultural fields (FAO, 2015). The Area C restrictions described above have also contributed to the intensive grazing of the limited areas accessible to Palestinian herders. According to Palestinian Ministry of Agriculture figures, pasture or rangeland covers 202,000 hectares (2,02 million dunum) but only 35 per cent of the rangeland is accessible for grazing to Palestinian herders. The Land Research Centre estimated that almost half a million dunums of land suitable for agriculture in Area C is not cultivated by Palestinians, either because of restricted access – the Land Research Centre estimates that 187,000 dunums are cultivated or occupied by Israeli settlements – or because of lack of water (quoted in (World Bank, 2014)). "Also, another 1 million dunums could be used for rangeland or forestry were current restrictions lifted." (World Bank, 2014). The Palestinian Ministry of Agriculture estimates that 23 per cent of the forest area of occupied Palestinian territory was destroyed between 1971 to 1999. Reforestation, terracing, and other practices that prevent soil erosion are complicated by Area C access restrictions. Non-sustainable management practices, including over-grazing of the available pastures and excessive use of fertilizers and pesticides, contribute to the degradation of land (EQA, 2012).

In addition to the factors described above, climate – including anthropogenic climate change – exerts

an influence on land and soil. The condition of 44 per cent of the area of the West Bank is classified as having an extremely arid, hyper-arid and arid climate, and this has, in turn, led to water and wind erosion (Dudeen, 2002). Climate change-related environmental risks, such as droughts and stormy rainfall (described in Chapter 8), are exacerbating pressure.

Changing crop patterns affect the ecosystem and soil biodiversity, reduce the density of plantations and the organic carbon in soil, and land productivity. Improper agricultural management, scarcity of water, uncontrolled domestic and industrial dumping sites and the heavy use of fertilizers are important in-situ soil deterioration causes in the West Bank area (ARIJ, 2007).

Soil degradation processes and related changes in the West Bank include pollution occurring from the discharge of raw and untreated wastewater into wadis and agricultural lands, remains from stone quarries and the stone and marble industry in the form of dust or slurry, and the excessive use of pesticides and chemical fertilizers, especially in areas with rainfall less than 200 mm per year. Such actions subsequently lead to changes in the chemical, physical, and biological properties of land and soils by clogging soil pores and destroying vegetation (SP, 2015).

Although Israel applies environmental laws in Israeli settlements and has established measures to control the unauthorized transportation of chemicals and waste products from Israel into the West Bank (as described above), both the Applied Research Institute Jerusalem and the Israeli non-governmental organization B'Tselem have expressed concern about the disposal of hazardous waste and wastewater from Israeli settlements and industrial zones located in the West Bank (ARIJ, 2015); (Aloni, 2017). The amount is estimated by the Palestinian Water Authority to be approximately 35 million m3/year from 64 sites in the West Bank (PWA, 2016). According to the Environment Quality Authority, this has led to large-scale pollution of land (EQA, 2016). However, no quantitative assessment of the state of soil pollution is currently available.

Soil erosion

The pressures above, which derive from human activity, have contributed to thin vegetation cover in many parts of the West Bank. The combination of unsustainable agricultural and herding practices, extreme climate events, fragile soil classes and harsh topography (steep to very steep slopes) lead to the erosion of the soil by wind and water.

Water erosion takes place in all of its forms (sheet, rill, gully, and tunnel) depending on geomorphology and rain intensity. Soil erosion assessment is a prerequisite for sound land use planning. Soil erosion risk is severe in the mountainous areas that are exposed to heavy rainfall. Soil erosion also occurs in areas with very steep slopes and low vegetation cover as in the case of eastern heights. Areas with more than 1 tonne/ha of soil loss comprise more than 50 per cent of the West Bank area (Dudeen, 2002).

Brown lithosols, regosols and loessial arid brown soils are the types of soil that are most prone to erosion. These soil types are abundant in the eastern slopes and Jerusalem. Soil texture also plays an important role in erodibility: for example, the surface horizon texture of brown lithosols, regosols, loessial arid brown and loessial serozems is comparatively coarse and thus more readily detached by raindrop splash. In the case of steep slopes with certain aspects, even terra rossa and brown rendzina soils, which are clayey, are exposed to a high degree of erosion (Ghanma, 2012). A study conducted in the southern Hebron region of the West Bank found 43 per cent of the area to be highly susceptible to erosion risks, leading the authors to recommend that soils be carefully managed and adequately protected during regular agricultural production (Land Research Centre, 2018).

Regarding wind erosion, there are no available data. There are indications that such erosion is taking place in the dry and coarse-textured eastern parts of the West Bank and the eastern and southern parts of Gaza Strip (ARIJ, 2007).

Surface soil sealing

The rate of soil loss due to surface sealing is relatively high in the occupied Palestinian territory. In the eastern parts of the West Bank, livestock herded for long distances in search of water and suitable pasture has resulted in serious trampling due to the increased traffic of animals (Ghanma, 2012).

Soil contamination

Soil contamination as part of land degradation is caused by the presence of xenobiotic (human-made) chemicals or other alterations in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals, or improper disposal of waste. The excessive and uncontrolled use of fertilizers is another source of contamination for both soil and groundwater (Ghanma, 2012). It is estimated that a total of 42,000 tonnes of fertilizers (chemical land manure) were used in the 2011 growing season: 30,000 tonnes in the West Bank and 12,000 in the Gaza Strip (PCBS, 2012).

Pesticides and insecticides are the main soil contaminant in irrigated areas. About 20,050 hectares of irrigated land in the West Bank (3.6 per cent of the land area) are intensively exposed to these chemicals. According to the Palestinian Authority, internationally banned pesticides are being used in some instances (SP, 2015). An estimated 502.7 tonnes of pesticides are used in the West Bank annually, consisting of about 123 types, 14 of which are internationally banned for health reasons. In the Gaza Strip, the annual rate of use of pesticides reached 893.3 tonnes, consisting of about 160 types. Of these, 19 are internationally banned for health reasons (PCBS, 2012). Israel reports that the entrance of pesticides into the West Bank is monitored by the Israeli Civil Administration "and subject to the same restrictions and criteria applied upon import to Israel", under guidance from the Israeli Ministry of Environmental Protection (GoI, 2019).

Unregulated or poorly regulated disposal of industrial and municipal waste is another source of soil contamination in the West Bank. Sewage streams, unregulated dumping sites and industrial waste disposal contribute to pollution (SP, 2015). Such pressures lead to the decline in soil fertility, organic matter, and an increase in toxicity. Such issues are further aggravated by the absence of fertilizer programmes based on soil nutrients analysis; excessive addition of chemical fertilizers without estimating the needs of plants; and a lack of consideration for the nutrients provided by organic fertilizers (EQA, 2018).

Another source of contamination arises from toxic materials left by bombing and other military actions. A detailed assessment of the environmental impact of military actions is given in the UNEP report Environmental Assessment of the Gaza Strip following the escalation of hostilities in December 2008 – January 2009 (UNEP, 2009). Crops are also contaminated when Israeli aircraft spray herbicides along the perimeter fence around the Gaza strip. Herbicides kill off the vegetation, thus reducing cover. In the last five years, Israeli planes have sprayed herbicides more than 30 times on the Israeli side of the perimeter fence. The herbicides are blown into Gaza, causing damage to crops. This, in turn, affects livelihoods (FA, 2019).

Crops, farmland and natural areas inside Israel, adjacent to Gaza, are also damaged by the launching of incendiary kites, balloons and other devices from Gaza. These devices cause environmental damage by starting fires. During the period 25 March to 10 June 2019, at least 70 fires were reported, resulting in the burning of over 30 hectares of land during this period. (United Nations, 2019).

Soil salinization

The lacustrine parent material in the Jordan Valley is an important source of soil salinity, in addition to other sources like using brackish or saline water in irrigation and the mismanagement of salt-affected soil and saline soil (Figure 23) (Ghanma, 2012).

In general, there is a close relationship between climate, parent material, moisture regime and soil salinity. Climate classification of the West Bank indicates that the soil in vast areas, particularly the eastern part, would be saline. On the other hand, since the soils of the West Bank originate mainly

Box 13: Soil erosion and ecosystem services

The ability to recover soil is extremely slow. Whereas 10 centimetres of soil can be lost within hours, natural processes of restoring this amount of soil can take almost 2,000 years. Damage to crops in such cases can amount to a 30 per cent yield loss. Damage to the topsoil can affect food production, but other benefits are also impaired such as the regulation of the flow of floodwaters, the diversity of flora and fauna, and the potential for leisure and recreational activities (Rinat, 2016).

Figure 23
Salinity Classes in the West Bank

from limestone, they have a comparatively high percentage of calcium. This fact leads to binding other monovalent ions such as sodium that helps in reducing soil salinity (Dudeen, 2002); (Ghanma, 2012).

Soils in the Jordan Valley and adjacent slopes (extremely arid and hyper-arid climate) exhibit a high degree of salinity. Soil associations in this area have a variable degree of salinity such as solonchaks, calcareous and loessial serozems, regosols and alluvial brown soils. Irrigation practices in the irrigated arable land of Jordan Valley have magnified the already existing soil salinity issue (Dudeen, 2002).

In areas where the groundwater is shallow, soils exhibit and have salinity problems due to the accumulation of salts from limited leaching capabilities. Even heavy textured soils have this problem, such as the grumosols in the plain of Jenin and the south-eastern part of the Nablus District (Dudeen, 2002).

Other areas of the West Bank are suffering from fluctuating soil salinity due to irrigation practices and soil quality. Salinity in these areas is fortunately reduced by rainfall which leads to salt leaching.

Also, soil types in these areas (terra rossa, brown and pale rendzina, and grumosols) which have a considerable area of irrigated arable land, are not as susceptible to soil salinity as those in Jordan Valley due to their heavy texture (Dudeen, 2002).

The decline of soil fertility
Intensive agricultural production activities lead, in many cases, to the deterioration of physical and chemical properties, the decline in organic matter and the loss of nutrients. There are no systematic records of soil fertility parameters that would help evaluate changes in fertility of the soils in the West Bank and Gaza Strip. However, records of agricultural productivity in many areas indicate the degradation of soil fertility (EQA, 2012).

The impact on land and soil resources
The pressures described above have contributed to the following impacts on land and soil (Ghanma, 2012):

Reduction of productivity: The decrease in agricultural and forage productivity leads to the abandonment of land, displacement due to poverty and fragile ecosystems. It ultimately leads to food insecurity (mainly in marginal areas and among vulnerable groups), lower income and high costs of economic activities, mainly livestock and agriculture.

Reduction of vegetation cover: Rangeland and natural grassland have also been negatively affected in the last three decades. The limited access of Palestinian herds to restricted areas resulted in intensive grazing on the remaining small land area.

Loss of biodiversity: Almost all ecosystems in the occupied Palestinian territory are under one type or another of driving force leading to biodiversity loss. For example, the Jordan Valley ecosystem comprising the Dead Sea is clearly a threatened ecosystem in terms of biodiversity loss due to land degradation.

Desertification, land degradation and high vulnerability to drought due to climate change. (UNEP, 2003); (EQA, 2012).

10.3 Responses

Policies and legislation

Palestinian Environmental Law No. 7 was issued in 1999 along with the Palestinian environmental strategy which afforded protection to land resources. The Ministry of Agriculture's strategy and policy framework was also adopted, which gave the protection of land resources a high priority. Although Israeli control over Area C constitutes an impediment to the implementation of this policy, the Palestinian Environment Quality Authority and the recently formed Palestinian environmental police are making a concerted effort to enforce the law, bylaws and regulations.

The Environment Quality Authority formulated a National Strategy to Combat Desertification in 2012. The overall objective of the strategy was to prevent, halt and where possible reverse the effects and impacts of desertification, land degradation and drought, in order to contribute to poverty alleviation, improve livelihoods of people and achieve sustainable development (EQA, 2012).

Institutional arrangements

The key governmental bodies working in this area are the Environment Quality Authority and the Ministry of Agriculture. Other institutes such as the Palestinian Water Authority, the Ministry of Finance and Planning, and the Palestinian Land and Water Settlement Commission are focused on administrative and legal ownership aspects. Other prominent non-governmental organizations working in the land and soil sector are the Land Research Centre, the Applied Research Institute in Jerusalem, Ma'an Development Centre, the Agricultural Union and Working Committee, and the Palestinian Agricultural Relief Committees. The following responsive actions are being implemented:

- Establishment of the Palestinian National Committee for Combating Desertification by the main stakeholders (Ministry of Agriculture and Environment Quality Authority) in cooperation with specialized Palestinian non-governmental organizations. The responsibility of the Palestinian National Committee for Combating Desertification is to develop a strategic framework and policies for combating desertification;
- Enhancing and motivating Palestinian non-governmental organizations and research institutes and centres to develop technical solutions to practical problems facing farmers and to convey the results to farmers through the Ministry of Agriculture's extension staff;
- Focusing on the empowerment of women and their role in controlling land degradation and adopting good agriculture practices;
- Conducting public awareness campaigns and improving extension programmes for farmers and cooperatives in cooperation with the main stakeholders in this area; and
- Encouraging capacity-building for farmers and rural communities to adopt good practices to preserve the environment and combat land degradation.

Programmes and actions for the conservation of land and soils

The following programmes and actions are being implemented for land and soil conservation (EQA, 2012):

- Implementing projects aimed at water harvesting and land reclamation;
- Preparing extension programmes to encourage farmers to introduce climate-smart agriculture approaches and agricultural practices that are environmentally friendly such as conservative agriculture, organic agriculture, zero or minimal tillage, rationalization of fertilizers and pesticides, introducing new drought and salinity-tolerant crops, and appropriate crop rotations;
- Enhancing the conservation of natural pastures and development of natural vegetation cover through effective sustainable rangeland management, such as the introduction of a rangeland protection bylaw, the organization of grazing schedules, the implementation of organized grazing, and pastoral rotation systems;
- Reducing wind soil erosion by planting trees and shrubs positioned perpendicular to the wind to act as berms and windbreaks, to mitigate the impact of wind soil erosion by deflecting the wind stream and reducing wind velocity;
- Mitigating soil erosion in sparsely vegetated areas which make up 21 per cent of the West Bank area by converting traditional planting systems from planted field crops to pastures with different and beneficial types of shrubs and grazing plants (agroforestry approach);
- Using contour farming systems for rangeland prone to water runoff and erosion;

- Rotating animals in pastures to allow for healthy renewal of vegetation growth in pastures;
- Allowing animals to graze harvested fields, as well as fallowing for one or two years;
- Utilizing household organic waste as fertilizer (composting) for selected crops in the farm or garden;
- Carrying out awareness campaigns among farmers regarding the importance of the sustainability of soil and land; and
- Bridging data and information gaps, and enhancing accessibility to available databases.

10.4 Conclusion and suggested actions

Land degradation and soil contamination are critical issues. Unless effective conservation measures are urgently introduced, continued soil degradation will have severe impacts on the environment and on agricultural productivity.

The following actions are suggested:

- Activate the Palestinian National Committee for Combating Desertification and develop a national strategy and action plan for achieving land degradation neutrality within the framework of United Nations Convention to Combat Desertification;
- Palestinian agriculture is deeply hindered by water scarcity. The agricultural sector uses nearly 45 per cent of all water available to Palestinians in the West Bank; however, only 10 per cent of the West Bank's cultivated area is irrigated. Efforts should be made to promote technologies to use drought-resistant crops, and to scale up initiatives to irrigate crops using treated wastewater – accompanied by work to increase acceptance of waste-water reuse (Dare, 2018);
- Scale up success stories and encourage innovative and indigenous practices, such as climate-smart agriculture, new technologies in water harvesting, crop rotation, and mixed crop canopy agriculture;
- Enhance grazing and rotation management to limit land degradation;
- Avoid, to the extent possible, tilled cultivation on fragile soils;
- Promote climate resilient community-based natural resource livelihoods and land rehabilitation interventions. The World Bank notes the potential for promoting non-timber forest products in the West Bank and Gaza such olive oil, honey, dates and medicinal plants: these directly generate goods for household consumption while creating primary and secondary income. Supporting the sustainable production, processing and marketing of non-timber forest products would expand income opportunities, particularly for women, youth, and poor and vulnerable households, while enhancing biodiversity, natural resource management and climate resilience (World Bank, 2019);
- Facilitate approaches such as agroforestry, including – where necessary – via enhanced coordination between Israeli and Palestinian authorities;
- Launch a scientific study of land and soil contamination and create a database of all information related to land degradation and soil contamination, and ensure public access to information; and
- Prioritize the integration of land and soil conservation with gender issues and food security in national development plan and strategies.

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Chapter 11: Disaster Risk Reduction

11.1 Introduction

In 2015, the United Nations General Assembly adopted the Sendai Framework, which is a voluntary, non-binding agreement, which recognizes that a primary role of the state is to reduce disaster risk. The United Nations Office for Disaster Risk Reduction defines a disaster risk as "the potential disaster losses in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period" (UNISDR, 2017).

The occupied Palestinian territory has been affected by complex humanitarian emergencies that have increased the vulnerability of the Palestinian population (OCHA, 2013). A comprehensive disaster risk reduction strategy would help in achieving the Sustainable Development Goal 13, which seeks *inter alia* to strengthen resilience against natural disasters.

National capacities for disaster risk reduction are generally weak in the region, but critically so in the occupied Palestinian territory. The Sendai Framework Data Readiness Review Report for the Government of Palestine identifies the need for institutional capacities, financial resources and technological resources as crucial for risk information and assessment (SP, 2017b). The United Nations Disaster Assessment and Coordination Mission Report identified the limitations of current legislation for broad risk management, calling for legislative improvements (UNDP, 2016). This chapter provides an overview of the various hazards, vulnerabilities, impacts and the existing institutional framework related to disaster risk management.

11.2 Status and trends of hazards

The occupied Palestinian territory faces several geophysical, hydro-meteorological, climate-induced, technological and human-induced conflict-related disasters. The Support Action for Strengthening Palestinian-administrated Areas capabilities for Seismic Risk Mitigation Project at the An-Najah National University has summarized the different hazard types in the occupied Palestinian territory along with their probability of occurrence and probability of damage (Table 31) (ANNU, 2013).

Table 31: Hazards and probabilities of occurrence and damage (ANNU, 2013); (Hawajri, 2016).

Disaster group	Hazard type	Probability of occurrence	Probability of damage
Natural	Floods	Low	Low / limited
	Earthquakes	High	High
	Droughts	Medium	High in the long run
	Land/mudslides, rock falls and avalanches	Medium	Medium-high
	Epidemic outbreaks of disease	Low	Low
Technological	Industrial accidents	High	Medium-high
Man-made complex emergencies	Population displacement/refugee influx	High	High
	Sea disasters	Medium	High in the long run
	Pollution of underground water	High	High
	Occupation, wars	High	High

In addition to the hazards described above, Gaza is vulnerable to storm surge events.

Geophysical risks: The greatest geophysical hazard in the occupied Palestinian territory is the risk of earthquakes and landslides. The risk is associated with the hilly terrain and the Dead Sea Transform, which is a tectonic plate boundary situated in the Jordan Valley. Many fatalities have been associated with historical earthquakes. The last major earthquake in the region, which was especially severe in Nablus, was in 1927 and resulted in the destruction of many hundreds of buildings and in the loss of 130 lives (ANNU, 2013). A recent, much weaker series of earthquakes hit the northern part of the Sea of Galilee in July 2018, with a maximum magnitude of 4.6.

Palestinian officials fear that an earthquake with a magnitude greater than 6.5 could result in extensive damage and casualties in the region (Melhem, 2018). The occupied Palestinian territory faces ongoing small to mid-scale disaster risks with the possibility of it resulting in a large-scale urban disaster.

Hydro-meteorological and climate hazards
Droughts and water shortages are a serious concern in the region due to its arid climatic conditions. At the same time, another hazard is flash flooding as a result of heavy rains. Winter storms are common: two of the more serious winter storms in 2013 highlighted gaps in the Palestinian government's preparedness in terms of disaster risk reduction and its lack of ability to respond to disasters (UNDAC, 2014).

Dust storms are also becoming increasingly intense and frequent in the region (UNEP, 2007). Dust storms not only pose a threat to human health in the affected regions by deteriorating the air quality (Figure 24) but also impact the economy of the region by reducing agricultural productivity, disrupting supply chains, etc.

In the West Bank, extreme weather conditions are becoming more frequent due to climate change. High rainfall intensity and interference of the natural infiltration processes by engineered surfaces are increasing the potential occurrence of flash floods and therefore intensifying the prevailing flood hazards in West Bank districts (Shadeed, 2019).

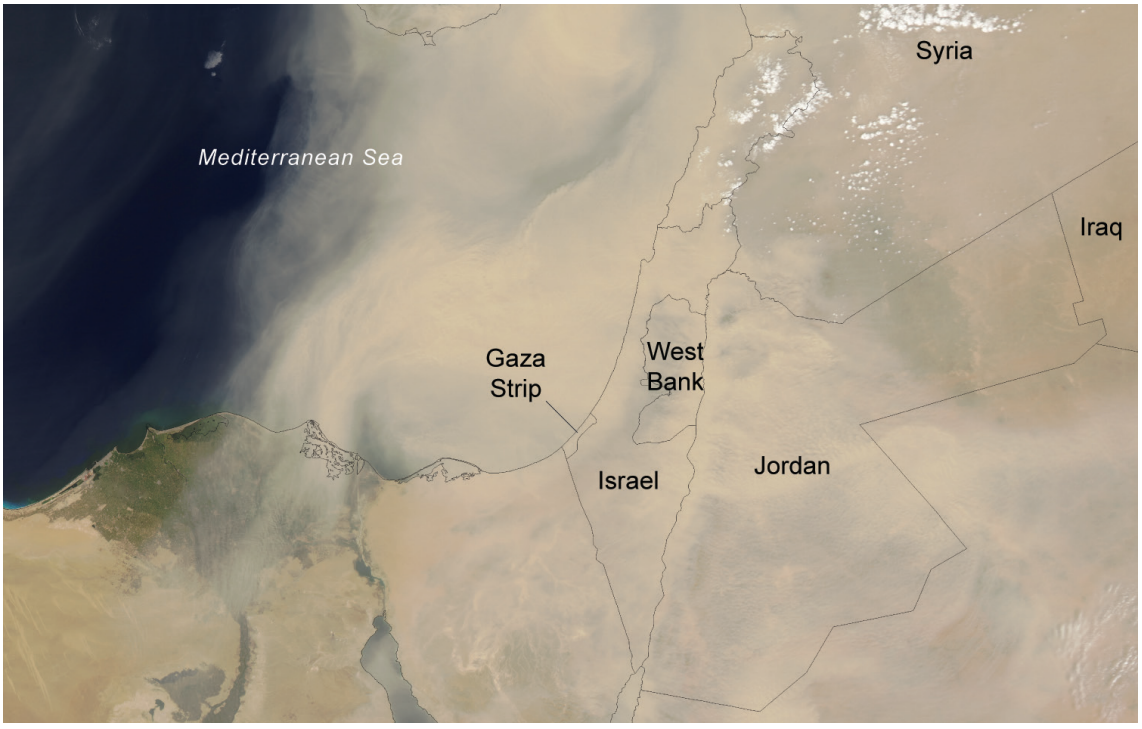

Figure 24
Satellite image of a dust storm over the Middle East and North Africa (MENA) region (NASA, 2015)

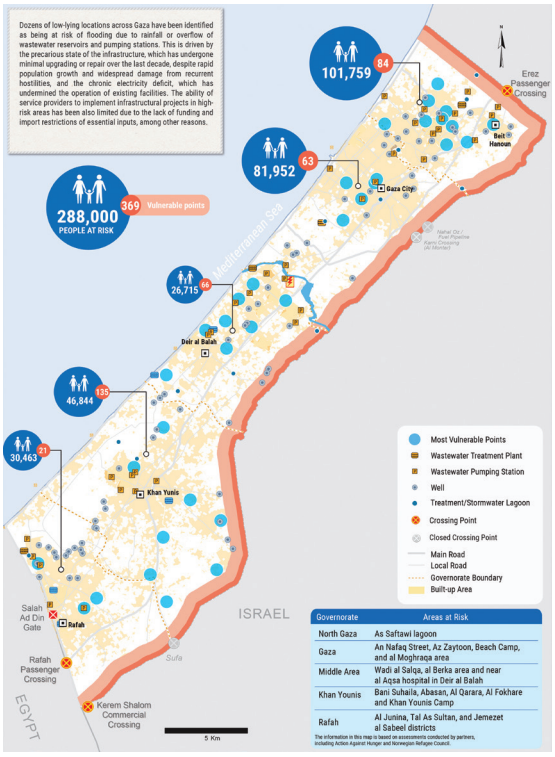

Figure 25
Areas at risk of flooding in Gaza (OCHA, 2019)

Medium to high flood risk areas cover 65 per cent of the West Bank. High flood risk areas are mostly located in the north-west whereas the very low and low risk areas are located in the south-east. This spatial trend is matched by the spatial distribution of rainfall and runoff potential.

Very high flood risk areas are in general sparsely distributed in the west of the West Bank with some concentration in the central areas (Jerusalem district) and in the north (Tulkarm, Qalqiliya, Jenin and Nablus districts). The very high flood risk potential in these areas might be a result of their higher runoff potential, rainfall values, population and low surface elevations.

11.3 Vulnerability factors

Vulnerability is a multidimensional concept that takes into account social, economic, political and environmental dimensions. There are three main contributory factors: risk, exposure and coping capacity. Measures of overall vulnerability should include both human and natural systems and the risks which affect them. Vulnerability factors are

those that increase the consequences of a disaster event. The vulnerability conditions of the occupied Palestinian territory, in general, could be classified as high to very high, driven by the following issues (UNDP, 2016):

Access restrictions: Israeli access and movement restrictions make the development of long-term disaster resilience difficult, and pose challenges to the national and international rescue and relief teams to access the affected areas during emergencies (UNDP, 2016).

Intra-Palestinian divide: The intra-Palestinian divide is detrimental to the development of a cohesive disaster risk management approach.

Infrastructure vulnerability: Most cities in the occupied Palestinian territory are earthquake-prone. Studies conducted by the Sciences and Seismic Engineering Centre on the vulnerability of buildings in the West Bank show that a third of the surveyed buildings are likely to be greatly damaged during an earthquake (UNDP, 2016). Another 40 per cent of buildings are likely to suffer moderate damage (UNDP, 2016). The situation in Gaza is expected to be similar. Poorly built refugee camps could be particularly vulnerable to earthquakes and floods. Other indirect yet crucial factors affecting infrastructure include transportation, electricity, water and telecommunications, which are also affected by the restrictions present in Area C of the West Bank, and especially in the Gaza Strip.

Social vulnerability: The lack of adequate information and awareness about disasters and the inability to cope with them due to the lack of economic resources are among the main reasons behind socioeconomic vulnerability. Children, elders and the economically and socially weakest people are likely to be more vulnerable than the rest of the population.

Economic vulnerability, recurrent fiscal crises
Volatility in economic growth and resource flow can threaten the ability of the Palestinian Authority to plan for disaster risk management.

11.4 Impacts

During the period from 1980 to 2013, approximately 411 disaster events were recorded in the occupied Palestinian territory, as shown in table 32. The Palestinian disaster loss database has records for 63 casualties, of which 18 were caused by structural collapse. These events caused significant damage to buildings: 67 houses were destroyed and 798 damaged, ruined mainly by flood and storms. Forest fire is the most frequent event in the country, followed by flooding, with 110 and 82 events recorded, respectively.
Agricultural production is sensitive to climate. Production of dates, olives and grapes is affected by changes to frost, hail, drought and rainfall patterns (amount and distribution). In 2015, frost destroyed the production of 170 hectares (3,825 tonnes) and partially destroyed 300 hectares (3,750 tonnes) in Hebron and Bethlehem governorates (EQA, 2016).

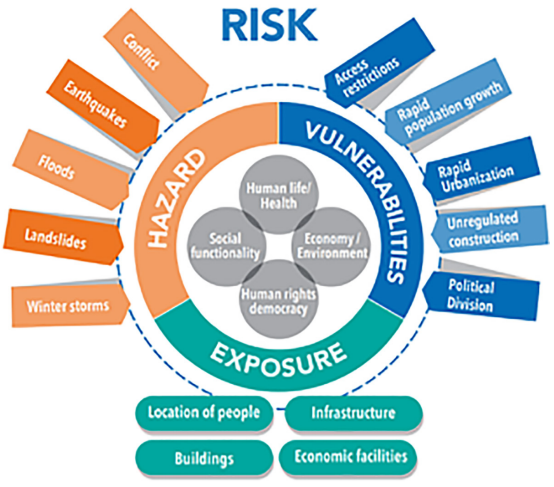

Figure 26
A schematic representation of risk, hazard, exposure and vulnerabilities (OCHA, 2017)

The winter storms of 2013 were among the more serious recent disasters, accompanied by heavy rains and flooding. With casualties in both the West Bank and Gaza Strip, field reports indicate that approximately 12,500 people across 190 communities were affected by the storms due to the negative impacts on residences and agricultural livelihoods. Several homes were destroyed by strong winds, temporarily displacing approximately 650 people. This disaster exacerbated the existing vulnerabilities of the region (Melhem, 2018); (OCHA, 2013). Damages and losses were estimated at over US$130 million (OCHA, 2013).
In 2015, the Khamseen dust storm engulfed the

Table 32: Distribution of disasters, damage and losses between 1980 and 2013 (UNISDR, 2015)

Hazard	Number of events	Deaths	Houses destroyed	Houses damaged
Structure	18	18	2	0
Rain	25	16	0	26
Floods	82	15	37	555
Storms	46	5	27	191
Cold temperatures	7	3	0	10
Thunderstorm	9	3	0	10
Snowstorm	29	2	1	3
Forest fire	110	1	0	3
Avalanche	1	0	0	0
Drought	11	0	0	0
Earthquake	3	0	0	0
Fog	1	0	0	0
Frost	25	0	0	0
Heatwave	30	0	0	0
Landslide	1	0	0	0
Windstorm	13	0	0	0
Total	411	63	67	798

region, with dust stretching up to 4 km into the air, raising dust levels to 140 times higher than the seasonal average (MNA, 2015). More recently, heavy dust storms blew across Jerusalem in January 2019, causing damage to properties and raising pollution to very high levels (TOI, 2019).

11.5 Response

The Palestinian Disaster Risk Management system consists of three nodes at a national level which was recently added to the normal functioning of the governmental organizational structures. These are summarized below.

National Disaster Risk Management Platform: The highest node for cooperation on disaster risk management at the national level is the National Disaster Risk Management Platform. This platform was established in 2017 by a Council of Ministers' Decree. Chaired by the Prime Minister, it includes ministers, authority chairs, governors, the President of the Palestine Red Crescent Society, and representatives from the private sector, academia, and non-governmental organizations. The platform serves as a venue for the above-mentioned officials to meet regularly and whenever convened by the Prime Minister to share information, and for post-disaster learning sessions (SP, 2017a). Members have designated roles that they undertake when disaster strikes.

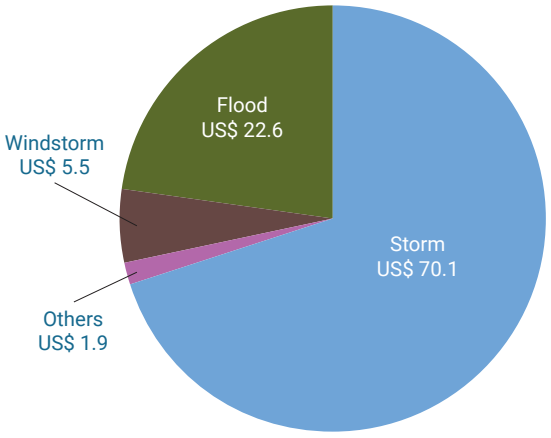

Figure 27
Nationally reported losses 1990–2014 (UNISDR, 2014)

National Disaster Risk Management Technical Team: The Council of Ministers' Decree also established a National Technical Team, constituted by technical representatives, corresponding to those in the National Disaster Risk Management Platform. The National Technical Team is chaired by the Head of the National Disaster Risk Management Centre and meets twice a year for post-disaster learning sessions, and whenever the Head of National Disaster Risk Management Centre decides to call a meeting. The National Technical Team members are also actively engaged with projects undertaken by the National Disaster Risk Management Centre throughout the year.

National Disaster Risk Management Centre: The national coordination mechanism is managed through the National Disaster Risk Management Centre, which acts as secretariat for the National Disaster Risk Management Platform and has the Prime Minister as its highest executive officer. The National Disaster Risk Management Centre staff plays a crucial role in providing expertise and coordinating activities for disaster risk management at a national level; it also serves as Sendai Focal Point for the United Nations Office for Disaster Risk Reduction. The National Disaster Risk Management Centre activities are organized such that representatives from all ministries, authorities, the Palestine Red Crescent Society, key civil society and private sector members, and international stakeholders are included in the activities. During normal times, the National Disaster Risk Management Centre is run as an office that manages national-level risk analysis activities, monitors and promotes mitigation activities, organizes disaster preparedness, leads post-disaster learning, and supports other stakeholders in performing such activities. The Centre manages all the national-level disaster risk management projects, supports the district, municipal and field levels, and coordinates operations during disasters.

Disaster coordination nodes: disaster response groups

During a disaster, representatives working at the National Disaster Risk Management Centre reprioritize their work and reorganize their efforts based on the functions of pre-defined and pre-trained disaster response groups, into which they are organized (SP, 2017a). Disaster response groups facilitate the following functions:

- The development of a common national situation overview among stakeholders;
- Short and effective communication lines;
- Effective cooperation between stakeholders at national and governorate levels;
- Discussions on strategies and goals as a basis for prioritizing operations;
- Requests for support from actors; and
- Planning.

To keep the number of disaster response groups within the span of control for the National Disaster Risk Management Centre staff, four are established at the National Disaster Risk Management Centre during disaster operations, each having a clear purpose, disaster risk management objectives and representatives (table 33) to ensure coordinated responses.

Furthermore, there are a number of non-governmental organizations and research centres, such as the Palestinian Red Crescent Society, the Earth Sciences and Seismic Engineering Unit, university research centres, and others playing an important role towards disaster risk management.

Several United Nations organizations work closely with the Palestinian Authority for the effective functioning of disaster risk management. Their functions include developing a protocol of cooperation between the Governments of Palestine, Israel, Egypt and Jordan to facilitate timely and effective responses, build capacity, increase awareness on safety measures, help

Table 33: Issues addressed by the four disasters response groups (SP, 2017a)

Disaster response groups			
Group 1. Basic human needs	**Group 2. Infrastructure and services**	**Group 3. Economy, culture and demographics**	**Group 4. Recovery**
What part of the population is affected? Where is the affected population? Are they injured, or in harm's way? Do they have shelter? Are their basic needs being met?	What damage and service interruptions have occurred? What is the impact on critical facilities? Are there environmental consequences? What are the immediate needs of society?	Any national economic issues in need of attention? What is the impact on the private sector? Any cultural issues that need to be considered? Any special needs among specific demographics?	How to rehabilitate lives? How to re-establish livelihoods? How to restore services and social networks? How to reconstruct from a risk mitigation perspective?

community preparedness, support emergency operation centers and early warning systems, and increase logistical capacity for disaster response (UNDAC, 2014).

11.6 Conclusion and suggested actions

The occupied Palestinian territory is prone to several hazards, and vulnerabilities worsen the potential impact of disasters. Past experience indicates that the existing national legislation is inadequate for effective disaster risk management (MoI, 2010). Progress has been made during recent years to establish a coherent disaster risk management system, but this now needs to be made more cohesive and extensive to ensure that the limited resources are mobilized effectively in a time of need. In this context, the following actions are suggested:

- The proposed draft Disaster Reduction Management Law (relating to the new institutional structures described above) should be finalized and enacted as soon as possible;
- New avenues and tools for financing, such as disaster risk finance which helps governments to shift from response to preparedness, and forecast-based financing by mainstreaming the "early warning>early action" model into disaster management, should be explored;
- Insurance solutions should be investigated to reduce humanitarian impacts, help poor and vulnerable people recover more quickly, increase local adaptive capacity and strengthen local resilience;
- Conduct thorough analysis with respect to the municipality and field level coordination to establish their responsibilities;
- An effective incident command system to be planned and established to suit Palestinian circumstances. The various stakeholders must be trained to operate under such a system;
- A comprehensive urban development plan should be developed for the future growth of Palestinian cities, such that strict seismic codes and standards are followed during construction to reduce infrastructure vulnerability to disasters;
- Steps should be taken to ensure that refugee camps are covered by response plans; and
- There is a need to train media and government professionals for real-time communication of credible information using radio and mobile devices from early warning systems.

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Chapter 12: Institutions

12.1 Introduction

This Chapter describes the work of, and interaction between, institutions in the occupied Palestinian territory that have responsibility for protecting and managing the environment. The legal frameworks relating to land and the environment originate in several historical periods and are applied in different geographical areas (Persson, 2016). Some institutional and governance frameworks that were originally envisaged as temporary have remained in place for decades. This has contributed to a situation in which different layers of legislation are being applied by different institutions, depending on the identity of the individual concerned and his or her precise location. These overlapping governance and legal arrangements complicate environmental management and protection.

12.2 Legal obligations of the occupying power

The United Nations Security Council has affirmed the obligation of Israel as the occupying power "to abide scrupulously by its legal obligations and responsibilities under the Fourth Geneva Convention relative to the Protection of Civilian Persons in Time of War, of 12 August 1949" (S/RES/2334 (2016)).

International legal obligations relevant to the protection of the environment during times of conflict and occupation are informed by different legal instruments, including as referenced in United Nations General Assembly Resolution 73/255 adopted on 20 December 2018. The issue is also under continuing consideration by the International Law Commission, as referenced in the first report on the protection of the environment in relation to armed conflicts by Special Rapporteur Marja Lehto, and presented to the International Law Commission at its seventieth session in 2018.

12.3 Environmental governance arrangements established before and during the Oslo process

In June 1967, the Israeli military began administering the occupied Palestinian territory. In 1981, Israel established the Civil Administration, a military body within Israel's Defence Ministry tasked with running civil matters, providing

and operating public services, and maintaining governance and public order (GoI, 2019).

Governance arrangements for the occupied Palestinian territory – including environmental governance – changed during the 1990s, following the signature of the Declaration of Principles on Interim Self-Government Arrangements by Palestine Liberation Organization Chairman Yasser Arafat and Israeli Prime Minister Yitzak Rabin, and the subsequent establishment of the Palestinian Authority. The Declaration of Principles was followed by a succession of agreements between Israel and the Palestine Liberation Organization, which are known as the Oslo Accords. In the 1995 Interim Agreement on the West Bank and the Gaza Strip, also known as Oslo II, Israel and the Palestine Liberation Organization agreed to divide the West Bank into three administrative divisions – Areas A, B, and C. A Palestinian Council would assume jurisdiction over "populated areas" (Areas A and B) during the first phase of Israeli redeployment. Area C – defined as "areas of the West Bank outside Areas A and B, which, except for the issues that will be negotiated in the permanent status negotiations" – would be "gradually transferred to Palestinian jurisdiction" (IMoFA, 1995).

Matters relating to environmental governance were covered in Annex III (Protocol Concerning Civil Affairs) of the Interim Agreement, which included requirements for natural resources management in Annex III, Appendix 1. The listed themes include agriculture, environmental protection, forests, nature reserves, parks, and water and wastewater management. Environmental issues were addressed in more detail in Article 12, which covers "sewage, solid waste, water, pest control (including anti-malaria activities), pesticides and hazardous substances, planning and zoning, noise control, air pollution, public health, mining and quarrying, landscape preservation and food production". This Article specifies, *inter alia*, that the "Israeli side shall transfer to the Palestinian side, and the Palestinian side shall assume, powers and responsibilities in this [environmental] sphere", that "In Area C, powers and responsibilities in this sphere… will be transferred gradually to Palestinian jurisdiction… except for the issues that will be negotiated in the permanent status negotiations…", and that "both sides will strive to utilize and exploit the natural resources, pursuant to their own environmental and developmental policies, in a manner which shall prevent damage to the environment, and shall take all necessary measures to ensure that activities in their respective areas do not cause damage to the environment of the other side" (IMoFA, 1995).

The arrangements described in the Interim Agreement were intended to endure for a "transitional period not exceeding five years", during which negotiations would lead to a "permanent settlement based on Security Council Resolutions 242 and 338" (United Nations, n.a.). Israel and the Palestine Liberation Organization did not, however, succeed in reaching a comprehensive peace agreement. The interim governance arrangements agreed by the Palestine Liberation Organization and Israel during the 1990s consequently remain largely in place today. Palestinian institutions manage civilian governance in Areas A and B, including those relevant to the environment. Israel has

Box 14: Report of the Special Rapporteur on the situation of human rights in the territories occupied since 1967 covering water, natural resources and the environment

In March 2019 the Special Rapporteur on the situation of human rights in the territories occupied since 1967, Michael Lynk, transmitted a report to the United Nations Human Rights Council, in Section III of which he focused "on whether Israel has respected its solemn duty under international law to protect the right of the Palestinian people to their water, their natural resources and their environment". The Special Rapporteur analysed International Humanitarian Law and International Human Rights Law pertaining to this question, and included in his report descriptions of the situation pertaining to water, natural resources and the environment from a human rights perspective. The Special Rapporteur concluded that Israel has "strayed extremely far" from its legal responsibilities as occupying power (Special Rapporteur on the situation of human rights in the Palestinian territories occupied since 1967, 2019).
Special Rapporteur Michael Lynk is appointed within the Special Procedures provisions of the United Nations Human Rights Council. He is independent from any government or organization, and serves in an individual capacity.

continued to exercise both civil and military control over Palestinian activities in Area C, primarily via the Coordinator of Government Activities in the Territories, and within it, the Israeli Civil Administration. The legal framework Israel applies in the occupied Palestinian territory is based on pre-1967 Jordanian, British and Ottoman law as amended by Israeli security legislation, with certain domestic laws applied directly to the population of Israeli settlers who reside within the West Bank on a personal rather than territorial basis.

Changes to the *de facto* arrangements for environmental governance in Gaza changed after 2007. Most of the Palestinian Authority's 106 Environment Quality Authority staff members in Gaza have not been operational since that time. (SIDA, 2014).

12.4 Joint Israeli-Palestinian processes for environmental management

During the Oslo peace process, joint Israeli-Palestinian structures were put in place to cooperate on environmental management in the occupied Palestinian territory. These structures included the Joint Environmental Experts Committee, the Joint Water Committee, and a team set up to collaborate on the disposal of hazardous waste. UNEP understands that the Joint Environmental Experts Committee has not met since 1999, although UNEP sought to facilitate a meeting of the Committee in 2005. Lack of political dialogue has prevented scientific and technical exchange.

As described in Chapter 7 above, the work of the Joint Water Committee was suspended between 2010 and the end of 2016. In August 2016, the Coordinator of Government Activities in the Territories initiated a meeting with the Palestinian side, during which the conditions for renewing the committee's activities were agreed upon. In January 2017, a renewal agreement was signed (Shapira, 2017). Approval to dig new wells, set water prices, and manage wastewater would stay under the responsibility of the Joint Water Committee. For infrastructure interventions, the Palestinian Water Authority would have authority to implement infrastructure projects (tank, water network, sewerage network and pipes) in Areas A and B, and inside the Palestinian villages located in Area C. The Israeli authorities would be informed regarding these interventions.

There have been several efforts to promote cooperation regarding hazardous waste, including a proposal in 2015 to implement a project on e-waste with involvement by local Palestinian stakeholders and Israeli academics, and funding from Sweden. This was not taken forward, however, since the design of the project extension and scale-up could not be agreed. Earlier efforts to regulate and jointly manage the disposal of hazardous waste have not been successful (Alleson, Levin, Brenner, & Al Hmaidi, 2013).

12.5 Israeli laws, policies and institutions for the management of the environment within the occupied Palestinian territory

The Government of Israel has assigned responsibility to the Israeli Civil Administration and the Coordinator of Government Activities in the Territories for environmental management in the occupied Palestinian territory. The Coordinator of Government Activities in the Territories is part of the Israeli Ministry of Defense and implements the Israeli Government's civilian policy towards the West Bank and the Gaza Strip. The Israeli Civil Administration is part of Coordination of Government Activities in the Territories and was established by the Israeli Government in 1981 to carry out practical bureaucratic functions within the territory captured during the 1967 war (COGAT 2019). It is the civilian authority that is tasked with addressing the needs of civilian populations, both Israelis and Palestinian, in Area C of the West Bank.

The Civil Administration includes an Environmental Protection Unit, which according to the Coordinator of Government Activities in the Territories "is responsible for the region from Mount Gilboa in the north to the southern point of Mount Hebron in the south, from the Jordan Valley in the east to the Shfela area enclosing it from the west". This unit "works to promote the protection and preservation of the environment and carries out enforcement measures against environmental hazards, which are usually shared by both populations in the region" (COGAT, 2016).

In addition to the Israeli Civil Administration and the Coordinator of Government Activities in the Territories, several other Israeli institutions are active in the occupied Palestinian territory or engage with Palestinian institutions and interlocutors on issues relating to the environment.

These include the Israel Nature and Parks Authority, the Israel Water and Sewage Authority, the Ministry of Environmental Protection, and the Ministry of Regional Cooperation. According to a communication from Israeli government officials to UNEP (11 March 2019), within Israeli settlements "authority lies with Israeli government ministries, and therefore, for example, the inspectors of the Green Police of [Israel's] Ministry of Environmental Protection have authority, but only with regard to legislation that is applied (and amended as relevant) by the Military Security Legislation". Israeli citizens located in the occupied Palestinian territory are also subject to personal (extraterritorial) application of some aspects of Israeli law (for example, with regard to waste disposal).

According to communications to UNEP from the Israel Civil Administration on 18 April 2019, Israel applies environmental laws in the West Bank as follows:

"Security Legislation in the Field of Environment in Judea and Samaria":

- Preparation of environmental impact assessments (Judea and Samaria), 2001;
- Maintenance of Cleanliness Decree (Judea and Samaria), No. 1160, 1986;
- Supervision of Certain Materials Decree (Judea and Samaria), No. 653, 1975;
- Transfer of certain dual-use materials and equipment to the Gaza Strip and Judea and Samaria under the Defence Export Control Law (Judea and Samaria), 1991;
- Road signs (Judea and Samaria), 1984;
- Import Goods Decree (Judea and Samaria), No. 1252, 1988;
- Electricity (Regulation and Operation), Production of Electricity from Biogas in Anaerobic Digestion Facilities, 2015;
- Nature Protection Decree (Judea and Samaria), No. 363, 1969; and
- Park Protection Decree (Judea and Samaria), No. 373, 1970.

The following are part of the environmental legislation in force in Area C in relation to the Palestinian population:

- Authority delegation as of 12.9.1993 under the (Jordanian) Public Health Law, No. 43, 1966; and
- Authority delegation as of 12.9.1933 under the (Jordanian) Industry and Industries Law, No. 16, 1953.

In addition to the above "Security Legislation" which applies to all of the West Bank, most Israeli environmental laws are de facto applied within jurisdiction of Local Councils of Israeli settlements by military decree. These laws include:

- Article A1 (Prevention of Water Pollution) of the Water Law, 1959;
- Abatement of Environmental Nuisances Law, 1961;
- Vehicular Air Pollution Regulations (under the Abatement of Environmental Nuisances Law), 1963;
- Prevention of Smoking and Exposure to Smoking in Public Places Law, 1983;
- Maintenance of Cleanliness Law, 1984;
- Abatement of Environmental Nuisance Law (Civil Claims), 1992;
- Hazardous Substances Law, 1993;
- Collection and Disposal of Waste for Recycling Law, 1993;
- Beverage Container Deposit Law, 1999;
- Tire Disposal and Recycling Law, 2007;
- Packaging Law, 2011;
- Environmental Protection Law (Inspection and Enforcement Authorities), 2011; and
- Prevention of Hazards of Asbestos and Harmful Dust Law, 2011.

There are differences between the environmental legislation enacted by Israel in the occupied Palestinian territory and the environmental laws applied in Israel. Some Israeli legislation is not applied in settlements. For example, the 2012 Israeli law covering 'Environmental Management of Electric and Electronic Equipment and Batteries' does not apply in settlements, and neither does the 'Price Control of Mixed Waste Decree', which (when applied inside Israel) "requires reporting of data on treatment of mixed waste by transfer stations and waste disposal sites" (GoI, 2019). Furthermore, hazardous waste treatment in the West Bank is regulated under the Order for the Administration of Local Councils, 1981. This military order applies only some of the Israeli national laws on environmental issues to settlements and Israeli industrial zones. While the Hazardous Substances Law and the Licensing of Business Law have been incorporated into the Order, the more recent Clean Air Law and the Environmental Protection Law (Pollutant Release and Transfer Reporting and Registration Obligations) were not, and therefore do not apply to Israeli waste treatment facilities in the West Bank (Aloni, 2017).

12.6 Palestinian laws, policies and institutions relating to the environment

As described in the assessment chapters above, several Palestinian institutions are involved in aspects of environmental policymaking, governance and management. These include the Ministry of Agriculture, the Ministry of Local Government, the Palestinian Water Authority, the Ministry of Finance and Planning, the Ministry of Health, the Ministry of Interior, the Energy and Natural Resources Authority, the Ministry of Transport, the Department of Meteorology, and the Ministry of National Economy. The Palestinian Environment Quality Authority is the Palestinian institution with lead responsibility for environmental policy development and management.

The Environment Quality Authority
The Environment Quality Authority was initially created through a Presidential decree in 1996. In 1998, it was transformed into the Ministry of Environmental Affairs. Thereafter, there were further changes in legal status between Authority and Ministry. Despite the frequent change of status, the Environment Quality Authority's mandate and resources have remained the same (SIDA, 2014).

According to the Palestinian Environmental Strategy 2011–2013, the Environment Quality Authority's mission statement is formulated as:

"Maintaining and protecting the environment, preserving human health, curbing and reducing the depletion of natural resources, combating desertification, preventing the aggravation of environment pollution, promoting environmental awareness and ensuring sustainable environmental development" (SP, 2016).

The Environment Quality Authority has regulatory and policy authority for all environmental issues. Its primary concern is the conservation and sound use of the natural environment while ensuring human well-being. The Environment Quality Authority has departments dealing with environmental resources, policy and planning, awareness and environmental education, projects, international relations, and administration and finance. The largest Environment Quality Authority department is that of environment protection, which includes regional offices (SIDA, 2014).

The Environment Quality Authority is located at the central level of the Palestinian government along with sector ministries and other lead agencies. Below the central level are two other levels, the regional and local levels. At the regional level, the 16 governors report to the Minister of Interior and supervise all government agencies in the district including the local police force. Governors are responsible for agriculture, water, education, health, telecommunications and trade, among others (SP, 2016).

Palestinian laws relating to the environment
There are four hierarchical levels of Palestinian environmental legislation and instructions: laws; bylaws, regulations and cabinet decisions; decisions by the competent minister; and standards, guidelines and instructions at technical levels (SIDA, 2014).

At the central government level, the Palestinian environmental laws in force in the occupied Palestinian territory (as of 2015) include (Samhan, 2016):

- Palestinian Environmental Assessment Policy;
- Palestinian Environmental Law Number 7 (1999);
- Law No. 24 of the Year 1943 and Modified Law No. 2 of the Year 1953 on Land Expropriation of Projects articles (3), (12), (21);
- Law No. 79 related to the Organization of Cities, Villages and Building Laws, articles (56), (57), (59); and
- Law No. 5 on the Organization of Local Bodies No. 5 Year 2011.c.

Environmental Law number 7 of 1999 is the main governing law for the Environment Quality Authority. It is based on Article 33 of the Constitution (Basic Law). The Environmental Law Number 7 gives a wide mandate to the Environment Quality Authority, with a leading responsibility in 10 technical fields (solid waste, water quality, wastewater, agricultural chemicals, marine environment, air and noise pollution, nature resource extraction, nature protection, biodiversity and desertification) and a supporting role in the areas of land use, radiation and environmental emergencies. This law also gives the Environment Quality Authority lead responsibility for environmental awareness, monitoring and inspection, and environmental approvals.

The environment is also regulated through other laws, the most important of which are the laws of Public Health, Local Government, Agriculture, Water, Natural Resources and the Law of Industry. Some environmental aspects are also regulated in the Labour Law and the Mining Law.

Local Governments establish regulations for the proper functioning of the local authority, with the authorization of the Ministry of Local Government. Areas related to the environment that is managed by the local government units include water and electricity supply, sewage management, town planning, building licensing and construction control, monitoring of public health, natural disasters, and flood and fire protection, among others (ARLEM; ECOR, 2009).

National Policy Agenda and Cross-Sectoral Environmental Strategy (2017–2022)
Environmental issues are addressed in the National Policy Agenda 2017–2022, which is the fourth Palestinian National Development Plan (SP, 2016). The National Policy Agenda has three pillars: Path to Independence, Government Reform, and Sustainable Development. It also includes 10 National Priorities, of which National Priority 10 on creating resilient communities includes strong linkages to the environment, agriculture, rural communities and culture.

Given the complex network of policies and legislation which directly and indirectly affect the environment sector, the Environment Quality Authority, through its Environmental Working Group, developed a cross-sectoral environmental strategy for 2017–2022 in line with the National Policy Agenda. Table 34 maps the objectives from the Environment Strategy with the National Policy Agenda policy interventions under National Priority 10 (Samhan, 2016).

Although the main oversight for environmental policy lies with the Environment Quality Authority, other relevant ministries are responsible for implementation. These policies were clustered under five strategic objectives, each of which is explained below:
Objective 1: Environmental pollution levels are low and controlled. This covers regulation of the safe use and disposal of agricultural manure, wastes and pesticides; regulating e-waste; better management of construction and other solid wastes; adopting clean and renewable energy sources for use in the domestic sector; reducing emissions in the transport sector (including shipping) and encouraging fuel-efficient transportation; and implementing a legal framework relating to pollution.

Table 34: Mapping Environment Strategy objectives within the National Policy Agenda (Samhan, 2016)

Environment Strategy Objective	National Policy Agenda policy interventions under National Priority 10
Environmental pollution levels are low and controlled.	• Improve pollution control • Improve solid waste management • Improve wastewater management
Natural environment and biodiversity are maintained and managed in a sustainable manner.	• Manage, protect and ensure the wise use of natural resources such as land, water and energy • Greening Palestine (protection of natural reserves, biodiversity and increasing green areas).
Measures for climate change adaption, combatting desertification, and dealing with environmental disasters and emergencies are adopted and implemented.	• Increase energy efficiency and increase the use of renewable energy sources • Strengthen capacity for disaster response and management

Objective 2: Natural environment and biodiversity are maintained and managed in a sustainable manner. This objective includes energy efficiency, green housing and infrastructure, use of water and reuse of treated wastewater, sustainable land management, and use, preservation of cultural and historical sites, and sustainable tourism.
Objective 3: Measures for climate change adaption, desertification control, and mitigating environmental disasters and emergencies are adopted and implemented. This objective involves implementing the Climate Change Adaptation Strategy (UNDP, 2009) across all sectors such as agriculture, natural disasters and infrastructure development, and encouraging green construction at all levels – schools, health facilities, houses and other infrastructure. Interventions such as rainwater harvesting and land management practices to help combat desertification are also included.
Objective 4: The environmental legal framework is updated, activated, and integrated, the institutional framework is empowered and efficient, and international cooperation is enhanced. Many existing laws and regulations require more effective implementation, such as in the sectors of solid waste management, licensing of industrial and economic establishments, environmental management plans in the construction and infrastructure sector, and incorporating environmental criteria in public procurement and purchasing.
Objective 5: The level of environmental awareness, knowledge, and practice is increased and enhanced. This strategic objective aims to improve knowledge through communication and information technology, formal and non-formal educational activities and encouraging scientific research. Stakeholder groups include youth, women and children. Partnerships with international organizations and neighbouring countries will be considered. Economic tools will be used to encourage behaviour change and promote green jobs.

12.7 Analysis of environmental governance

This section provides a brief assessment of environmental governance in the occupied Palestinian territory. Three sets of environmental governance challenges are identified. First, the mechanisms for cooperation between Israeli and Palestinian institutions around environmental governance and management do not function effectively. Second, environmental governance is complicated by the different institutions involved, the simultaneous application of different legal and administrative frameworks, and by limited Palestinian access to parts of the occupied Palestinian territory. Third, Palestinian institutions with responsibility for environmental governance face internal challenges, relating to resources, capacity and the situation in Gaza.

The analysis draws on assessment findings covered in previous chapters of this report, and on discussions with stakeholders undertaken during UNEP field visits. This analysis also includes findings from external parties (World Bank, the Swedish International Development Cooperation Agency and others) on the performance of environmental institutions. The Swedish International Development Cooperation Agency reviewed the Environment Quality Authority (SIDA, 2014) and commissioned a further review of internal Environment Quality Authority management and control in 2019 (KPMG , 2019). The World Bank assessed Palestinian capacity to implement environmental and social safeguards (World Bank, 2017). Although the World Bank analysis was restricted to environmental and social safeguards capacity, its findings are relevant to assessing the overall Environment Quality Authority capacity (World Bank, 2015).

Mechanisms for Israeli-Palestinian cooperation around environmental governance and management
Although mechanisms for cooperation were agreed between Israeli and Palestinian institutions for the joint management of water, the environment and hazardous waste, none of these – with the exception of the Joint Water Committee – has really functioned. In some cases, local, community-level efforts based on elements of resolving technical issues have achieved some success in reaching mutually agreeable solutions – but they have frequently foundered when attempts were made to scale up.

Limited official communication and coordination between the two sides on matters of environmental reporting and regulation have limited the scope of efforts to promote environmental protection. There is, at present, no fully functioning system of industry approvals, licensing, monitoring and inspections, linked to an information system for

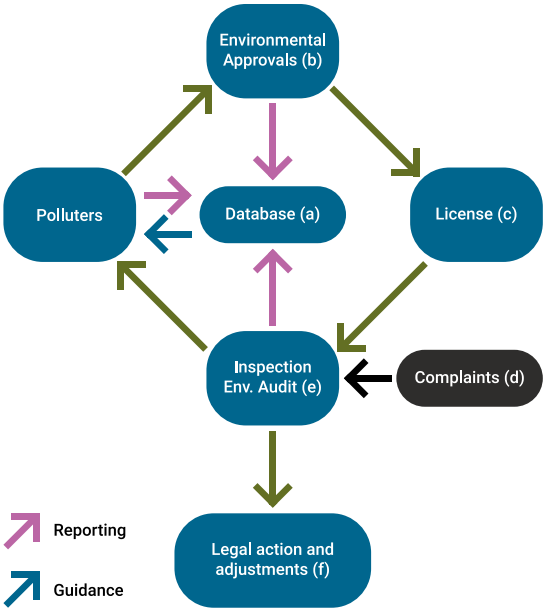

Figure 28
The environmental protection circle (SIDA, 2014)

basic tracking, reporting and regulation (Figure 28). In settlements, Israel applies licensing and monitoring mechanisms "similar to those in Israel, although less exhaustive on certain aspects" (GoI, 2019). As noted in Chapters 6, 7 and 8, the absence of a functioning system for monitoring and inspection, reporting and law enforcement hinder pollution reduction (SIDA, 2014).

As the flow of information on the state of the environment breaks down, environmental degradation is more likely to occur.

Application of different legal and administrative frameworks

As noted in Chapter 1 of this report, different environmental governance arrangements and laws are being applied to different individuals living within the occupied Palestinian territory. Palestinian citizens located in Areas A and B are subject to Palestinian environmental law, but the Palestinian Authority is unable to apply these laws in Area C or East Jerusalem. Restrictions on access by Palestinian officials to large parts of the West Bank, including East Jerusalem, have a deep impact on the Palestinian Authority's capacity to manage the environment and natural resources in these areas. In Area C, both Palestinian and Israeli citizens are subject to military laws applied by the Israeli Civil Administration. But Israeli citizens located in Area C are also subject to Knesset legislation that is applied to them directly.

In certain spheres – including hazardous waste treatment – some, but not all, of the Israeli national laws on environmental issues are applied to settlements and Israeli industrial zones. The Clean Air Law and the Environmental Protection Law (Pollutant Release and Transfer Reporting and Registration Obligations) are not applied to settlements (nor are they applied to all industrial plants in Israel (GoI, 2019)). Some legislative discrepancies exist in the regulation of plants (including waste treatment plants) on either side of the Green Line.

Multiple layers of governance have contributed to gaps in data and coordination. These gaps have led to persistent environmental degradation in the occupied Palestinian territory, either through neglect or because individuals exploit the situation for commercial gain. Environmental degradation affects both Palestinians and Israelis.

The implications of this lack of clear environmental governance have been recognized by the Israeli State Comptroller. In a May 2017 report on transboundary water pollution, the Comptroller describes "serious and unreasonable gaps" in data available to Israeli institutions regarding wastewater treatment; "bureaucratic obstacles and deficient treatment" by the Israeli institutions involved; and "above all an absence of a single, overseeing entity to manage" environmental issues. The Comptroller adds that "The Government of Israel has not yet formulated a policy for cross-border environmental management and for the management of water pollution in particular, and has not decided on any single government entity to be charged with this issue and manage it with responsible bodies". This is contributing to a "serious environmental hazard," which "affects Israel's political-security situation and its status in the world" (Shapira, 2017).

Challenges facing Palestinian environmental governance institutions

The Environment Quality Authority's mission statement is broad, yet its capacities are limited. A review of its internal systems, conducted in 2019, found "adequate internal controls specifically within the financial administration and control of expenditures", but also identified deficiencies in

the Environment Quality Authority's standards, structures and processes including "an inaccurate organigram, limited functional job descriptions, management and support staff vacancies, capacity constraints and limited systematic management practices. Furthermore, key positions remained vacant, including the post of Director-General for environmental protection" (KPMG , 2019).

This review also highlighted that the Environment Quality Authority's responsibilities "far exceed its current resources and capabilities. Interviews and documentation indicate that the main risks and challenges include limited Palestinian sovereignty over its land, legislative framework gaps related to waste management, an inadequate monitoring and inspection system, a lack of public environmental awareness, the political situation and the [Environment Quality Authority's] limited financial and human resources." (KPMG , 2019)

Funding for environmental programmes constitutes another challenge. The majority of environmental programmes in the occupied Palestinian territory entirely depend on financial support from international donors. Several of them, particularly short-term programmes implemented by small non-governmental organizations, are not sufficiently institutionalized within the organizations implementing them. Accordingly, the long-term sustainability of projects is then challenged when the funding disappears (ILO, 2018).

Local-level capacity gaps: Local government units lack the technical capacity for managing wastewater, solid waste, industrial pollution, and hazardous waste on the ground with effective delivery systems (SIDA, 2014). Local government units vary in size and capacity: some have well-functioning technical engineering departments, while others have low levels of staff or may be missing expertise and coordination systems to manage impacts and contribute to development planning (World Bank, 2015).
The World Bank assessment found that local government units do not systematically monitor the environment and social impacts from projects. Yet, in the units there is recognition of environmental sustainability and the desire for projects to contribute to better sanitation, reduced pollution and a better quality of life, as well as strengthened institutions (World Bank, 2015).
Incoming complaints are the main drivers for inspections at the local level and do not arise through standard monitoring and reporting processes. Such an approach is reactive and cuts off inspections from the rest of the environmental protection circle (see Figure 28). The Environment Quality Authority should instead provide proactive leadership with clear priorities, rather than relying on complaints (SIDA, 2014).

Knowledge management: There is no comprehensive national environmental information system in place for monitoring the state of the environment in the occupied Palestinian territory. In 2008, the National Team for Development of Environmental Information System was formed and later reactivated in 2011, led by the Palestinian Bureau of Statistics. The Environment Quality Authority acts as Secretary to the National Team. The Palestinian Bureau of Statistics has developed cooperation memoranda with ministries and civil society organizations concerning data exchange. Several different, and only partly compatible, indicator systems are being used or are under development, without clear links to the strategic environmental objectives (SIDA, 2014). These systems are:

- The Palestinian Environmental Information System, with 245 approved indicators;
- European Union Neighbours' Shared Environmental Information System, with six indicators (two for solid waste, two for wastewater and two for industrial pollution);
- Start of a pilot for the Pollutant Release and Transfer Register, with 91 indicators;
- Arab league reporting (45 indicators);
- National Development Plan (12 indicators) and Millennium Development Goals reporting;
- Example indicators (29) in the Environmental Strategy 2014–2016; and
- 50 indicators mentioned in plans for a State of Environment report (SIDA, 2014).

Unless such indicator systems are made mutually compatible and initiatives brought to fruition, the supporting role of an information system for environmental management cannot be achieved (see box 15).

Box 15: Data needs and data gaps

Draft bylaws have been developed for natural resource extraction, with focus on the stone and marble industry. The Environment Quality Authority should possess the necessary expertise for long-term sustainable use of natural resources. However, without data and information on what could be a sustainable rate of extraction, and the air and water pollution that results, the Environment Quality Authority cannot provide the necessary management responses. Such data and information collection and processing are problematic as they depend on the Environment Quality Authority having full access to Area C, where the resources are located (SIDA, 2014), and an ability to control and issue licenses for quarrying.

Furthermore, the lack of legal obligations for environmental information and reporting means that data collection, and thus an understanding of the problems, remains weak. The lack of a national database of polluters and pollutants means that pollution risks remain unknown (SIDA, 2014). Environmental data are crucial for enforcement and compliance, and to inform policy and decision-making. Development of a national indicator database in line with the National Policy Agenda, the Environment Strategy and the Sustainable Development Goals would ease collection of information against each indicator.

The Palestine Central Bureau of Statistics should take the leadership role for environmental statistics, decentralizing the data collection against indicators to the sectors and lead agencies. The Palestine Central Bureau of Statistics and the Environment Quality Authority may consider setting up a joint task force to agree on a list of priority environmental indicators aligned with relevant SDG indicators and a data collection system adhering to the principles of the United Nations Framework for Development of Environmental Statistics for monitoring progress towards the Sustainable Development Goals, building upon their core competencies and limited financial resources.

Environmental governance in Gaza: The lack of cooperation among the three "duty bearers" impedes the delivery of services and environmental protection:

1. Israel, as occupying power (see Israel's obligations in Section 12.3), maintains effective control over sea and land boundaries, and directly controls the flow of electricity, building materials and spare parts. Such resources are required to process the solid waste and wastewater processing infrastructure;
2. The *de facto* authority (Hamas) has political control over Gaza, but lacks the technical capacity to deliver services; and
3. The Palestinian Authority has technical capacity but is not able to operate in Gaza as it did before 2007.

The scale of environmental degradation affecting Gaza has been described in the assessment chapters of this report. Each of these duty bearers must recognize that the environmental degradation that is occurring now may take decades to reverse, and take appropriate steps to protect the environment.

Public participation: The World Bank assessment found that public participation and disclosure requirements for environmental and social impact assessments are weak. For example, for those projects requiring a full environmental and social impact assessments, public availability of the documents is required. However, the actual process of public review and comment was found to be onerous and resulted in environmental and social impact assessments being relatively inaccessible. Beyond being the only vehicle for lodging complaints, public awareness and participation are critical for community involvement in environmental management (World Bank, 2015).

12.9 Conclusion

The Palestinian Environment Quality Authority faces numerous challenges in achieving its mandated objectives of "maintaining and protecting the environment, preserving human health, curbing and reducing the depletion of natural resources, combating desertification,

preventing the aggravation of environment pollution, promoting environmental awareness and ensuring sustainable environmental development". While addressing institutional capacity and data gaps would be beneficial, a sustained improvement would require structured engagement between Palestinian and Israeli institutions to address environmental issues, and a substantial change to the situation in Gaza.

The Government of Israel has a responsibility to address environmental degradation – both to the inhabitants of the territory it occupies, and to its own citizens. The Israeli State Comptroller has described water pollution as "the most serious environmental hazard that crosses the Green Line faced by the State of Israel", one that "harms Israel and its neighbour's groundwater reserves, public health and the quality of life" (Shapira, 2017). The United Nations Country Team has emphasized that as long as Israel remains the occupying power, "the ultimate accountability for Palestine's ability or failure to reach the global Goals articulated in the 2030 Agenda" – including those relating to the environment – "remains with the Government of Israel" (UNCT, 2016). Degradation of the environment in the occupied Palestinian territory does not only affect Palestinian people, although the impacts on Palestinians are most severe. People living in neighbouring countries, including Israel, Jordan, and Egypt, are also impacted by degradation of the air, soil, freshwater courses and the Mediterranean Sea.

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Chapter 13: International obligations and commitments

13.1 Introduction

The State of Palestine has entered into regional and international agreements regarding the mutual respect of environmental resources and spaces shared both regionally across political boundaries, such as water, wildlife and habitats, and globally, such as hazardous waste, biodiversity and the climate.

13.2 Regional agreements

In their 1995 Interim Agreement, the Palestine Liberation Organization and Israel agreed to adhere to principles and standards regarding transboundary issues (UNEP, 2003).

The State of Palestine is a member of the League of Arab States and participates in its environment-related activities, such as the Council of Arab Ministers Responsible for the Environment. It also participates in other Arab League organizations, including the Arab Centre for Studies of Arid Lands and Desertification, the Arab Organization for Agricultural Development and the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (UNEP, 2003).

The State of Palestine is not Party to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, also known as the Barcelona Convention. The Barcelona Convention and its six protocols are the legal instruments governing specific themes of protection of the marine environment and coastal region of the Mediterranean. It governs the Mediterranean Action Plan (MAP) (UNEP/MAP, 2016). The Palestinian Authority regularly participates in Mediterranean Action Plan activities, and is invited to attend as an observer the meetings of the Mediterranean Commission on Sustainable Development, the advisory body to the Contracting Parties of the Mediterranean Action Plan. In 2005 and 2015, the Palestinian Authority received external funding to prepare and submit national action plans to combat pollution from land-based sources as required by Article 5 of the Land-Based Sources Protocol of the Barcelona Convention (UNEP/MAP, 2016).

The Palestinian Authority has secured funds to implement specific national components of regional and sub-regional projects from the Global Environment Facility (UNEP, 2003); (GEF, 2019). Examples of Global Environment Facility-funded projects with Palestinian participation include the following:

- The Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem, which undertook the Med Partnership 2009–2015 project. This helped to further policy, legal and institutional reforms in the partner countries, and provided funds to address pollution and biodiversity hotspots, critical habitats and species, and other priority areas under stress; promote integrated approaches for the sustainable use of marine and coastal resources; reduce pollution from land-based sources; and integrate climate considerations into national marine and coastal planning.
- ClimVar and Integrated Coastal Zone Management 2012–2015, a sister project to the Med Partnership, promoted integrated coastal zone management in countries sharing the Mediterranean to address the impacts of climate variability and change in coastal zones. The project developed the Regional Climate Change Adaptation Framework for the Mediterranean Marine and Coastal Areas, adopted by the Conference of Parties (COP) 19 in 2016 (UNEP).

13.3 Multilateral environmental agreements

Multilateral environmental agreements complement national legislation and bilateral or regional agreements. Multilateral environmental agreements form the overarching international legal basis for global efforts to address particular environmental issues. They play a key role in a country's framework of environmental laws and conventions (UNEP, 2016).

On 29 November 2012, the United Nations General Assembly passed resolution 67/19 granting the State of Palestine non-member observer state status (UN, 2012). At the United Nations Conference on Sustainable Development (Rio+20), held in Brazil in June 2012, world leaders agreed to establish universal membership in the UNEP Governing Council. When the UNEP Governing Council designation was changed to the United Nations Environment Assembly in March 2013 (resolution A/RES/67/251), Palestine, as an Observer State, became eligible to participate in discussions and decision-making on issues that affect the state of the environment and global sustainability, along with all the 193 United Nations Member States, Observer States, and other stakeholders (UN, 2013).

Table 35: Environmental conventions and treaties signed by the State of Palestine (MoFA, 2019)

Environmental conventions / treaties	Entry into force
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Rotterdam Convention on the Prior Informed Consent Procedure for certain hazardous Chemicals and Pesticides in international trade, the Stockholm Convention on Persistent Organic Pollutants	2 April 2015
Convention on Biological Diversity, 1992	2 April 2015
Cartagena Protocol on Biosafety to the Convention of Biological Diversity, 2000	2 April 2015
Convention on the Law of the Non-Navigational Uses of International Watercourses, 1997	2 April 2015
United Nations Framework Convention on Climate Change (UNFCCC), 1992	18 December 2015
Paris Agreement under the United Nations Framework Convention on Climate Change, 12 December 2015	22 April 2016

Box 16: The Basel Convention on Hazardous Waste

The State of Palestine ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal effective on 2 April 2015 (UNEP, 2019). The State of Israel is also Party to the Convention. The Convention's overall goal is to protect human health and the environment against the adverse effects of hazardous wastes.

The following text illustrates some of the general obligations:
"2. Each Party shall take the appropriate measures to:
(a) Ensure that the generation of hazardous wastes and other wastes within it is reduced to a minimum, taking into account social, technological and economic aspects;
b) Ensure the availability of adequate disposal facilities, for the environmentally sound management of hazardous wastes and other wastes, that shall be located, to the extent possible, within it, whatever the place of their disposal;
(c) Ensure that persons involved in the management of hazardous wastes or other wastes within it take such steps as are necessary to prevent pollution due to hazardous wastes and other wastes arising from such management and, if such pollution occurs, to minimize the consequences thereof for human health and the environment;
(d) Ensure that the transboundary movement of hazardous wastes and other wastes is reduced to the minimum consistent with the environmentally sound and efficient management of such wastes, and is conducted in a manner which will protect human health and the environment against the adverse effects which may result from such movement;
(e) Not allow the export of hazardous wastes or other wastes to a State or group of States belonging to an economic and/or political integration organization that are Parties, particularly developing countries, which have prohibited by their legislation all imports, or if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner, according to criteria to be decided on by the Parties at their first meeting;..." (UNEP, 2019).
Thus, the Convention defines and places various obligations on Parties to prevent and combat illegal traffic in hazardous and other wastes, including to cooperate with a view to achieving the object of Article 9 on illegal traffic.

There is a mechanism for Parties to transmit to the Secretariat information on cases of illegal traffic through a form or their national reports. In its 2017 report to the Basel Convention Secretariat, in response to the question about a provision in legislation to prevent illegal traffic of hazardous and other wastes, Israel replied that: "Hazardous Substances Regulations (Import and Export of Hazardous Wastes), 1994 provide the legal basis for implementing the Basel Convention in Israel. The Regulations Determines that a person shall not import into, and exported [sic] from Israel hazardous waste unless he got a permit from the Commissioner and in accordance with its conditions, and after it has been proved to the satisfaction of the Commissioner. Imports or exports are made only from or to a State that is a party to the Convention; In exports – the competent authority in the country of destination, in accordance with the Convention, has agreed in writing to accept." (UNEP, 2017). Parties may use a notification system under the Basel Convention to report the unauthorized transfer of hazardous wastes. Israel also notes in communications to UNEP that the Palestinian Authority has made complaints "regarding illegal transfer to the Secretariat of the Basel Convention prior to or simultaneously with notification to the Israeli authorities, thereby undermining effective enforcement measures by Israel to solve the problem. In our experience no other country notifies the Convention Secretariat in this way rather than taking steps to solve the problem between those involved" (GoI, 2019).

Since attaining the status of non-member observer state in the United Nations, according to the Palestinian Ministry of Foreign Affairs (MoFA; Personal Communication), the State of Palestine has signed over 80 treaties, conventions and agreements, of which a number are related to the environment, as shown in table 35 (MoFA, 2019). The criteria for selecting treaties for ratification include those most highly recognized by the international community, treaties that best protect the rights of the Palestinian people, treaties with many signatory states, treaties that are monitored and enforced, and those that can otherwise support Palestinian interests.

Boxes 16 and 17 illustrate some of the commitments for signatories enshrined in the Basel Convention (box 16) and the Biodiversity Convention (box 17) as case examples.

On 20 January 2015, the State of Palestine acceded to the United Nations Convention on the Law of the Sea, effective 1 February 2015 (SP, 2015a). The Convention sets out the legal status of the territorial sea, the air space over the territorial sea and its bed and subsoil, and the rules for all ships on the innocent passage in the territorial sea. Regarding the environment, it provides the cooperative agreement for navigational and safety aids, and other improvements; the prevention, reduction and control of pollution; the conservation of living resources of the high seas; and the protection of the marine environment (United Nations, 1982).

More recently, on 17 March 2016, the State of Palestine gained accession to the United Nations Framework Convention on Climate Change, becoming the 197th party to the Convention (EQA, 2016a). This new status is significant for a number of reasons: it enables the State of Palestine to advocate for its domestic needs and interests at the international environmental level, as well as access financial resources from the Global Environmental Facility, the United Nations Framework Convention on Climate Change financial mechanism administering both the Least Developed Countries Fund and the Green Climate

Box 17: The State of Palestine and the Convention on Biodiversity

The United Nations Convention on Biodiversity is an international, legally binding treaty. Its three main goals are the conservation of biodiversity, the sustainable use of biodiversity, and the fair and equitable sharing of the benefits arising from the use of genetic resources. Its main precepts are as follows:

- Ecosystems, species and genetic resources should be used for the benefit of humans, but in a way that does not lead to the decline of biodiversity;
- Substantial investments are required to conserve biodiversity, but they will bring significant environmental, economic and social benefits in return;
- The ecosystem approach, an integrated strategy for the management of resources, is the framework for action under the Convention; and
- The precautionary principle states that where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat (CBD, 1992).

On 2 April 2015, the State of Palestine became a Party to the Convention on Biodiversity. In its fifth National Report to the Convention, the State of Palestine declared that its Environment Quality Authority would update the national biodiversity strategy and action plan, prepare endangered species lists and build its capacities and those of national stakeholders in the field of biodiversity. The report also noted, however, that although Palestine is committed to implementing the Convention, it has not yet ratified two protocols to the Convention on Biodiversity: the Nagoya Protocol on Access and Benefits Sharing of Genetic Resources and the Cartagena Protocol on Biosafety. Also, it has no further national laws or administrative mechanisms related to biosafety, access to genetic resources and associated traditional knowledge, or on benefit-sharing from their use, which constrains the achievement of significant benefit-sharing (SP, 2015).

Fund. In 2019, the State of Palestine also received its first Green Climate Fund funding, together with Agence Française de Développement (AFD, 2019).

On 22 April 2016, the State of Palestine was one of the first states to sign and ratify the Paris Agreement, which entered into force on 4 November 2016 (EQA, 2016a). The key aim of the Paris Agreement is to engage the Parties to keep the global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C (UNFCCC, 2015).

Although the Palestinian Government prioritizes adaptation to climate change, it is also committed to reducing greenhouse gas emissions in line with the United Nations Framework Convention on Climate Change goal to prevent the continued rise in greenhouse gas concentrations. On 11 November 2016, the State of Palestine submitted its Initial National Communication Report 1, in compliance with the Convention's requirement that all Parties report on the steps they are taking or envisage undertaking to implement the Convention (EQA, 2016a). This demonstrated the Palestinian Government's commitment to tackling climate change by submitting its National Adaptation Plan only eight months after the Initial National Communication Report, becoming the sixth country to submit its National Adaptation Plan to the Convention (EQA, 2016b). The National Adaptation Plan identified "a wide range of 'highly vulnerable' issues in relation to water, agriculture and food that also affect the vulnerability of other themes/ sectors" (EQA, 2016a). The State of Palestine also submitted its first nationally determined contributions, in accordance with the provisions and the Convention's Conference of the Parties decisions and the Paris Agreement.

The State of Palestine demonstrates interest in becoming a party to multilateral environmental agreements and in implementing them at the domestic level. At the request of the Environment Quality Authority of Palestine, in December 2018 UNEP provided training on environmental law and diplomacy, which was attended by almost 30 officials.

13. 4 Conclusion and way forward

Mechanisms for implementation and compliance under the conventions described here provide an opportunity for both parties to strengthen their cooperation. Israel has a responsibility to uphold its own commitments to multilateral environmental agreements where they apply in the occupied Palestinian territory. Table 36 provides a list of the multilateral environmental agreements to which both Israel and the State of Palestine are committed.

Table 36: Palestine and Israel: multilateral environmental agreements (InforMEA)

Treaty	Palestine	Israel
Agreement on the Conservation of African-Eurasian Migratory Waterbirds	-	Ratification
Basel Convention	Accession	Ratification
Cartagena Protocol	Accession	
Convention on Biological Diversity	Accession	Ratification
Convention on International Trade in Endangered Species of Wild Fauna and Flora	-	Ratification
Convention on Migratory Species	-	Party
Barcelona Convention	-	Ratification
Prevention and Emergency Protocol	-	Ratification
Land-Based Sources Protocol	-	Ratification
Specially Protected Areas and Biodiversity Protocol	-	Ratification
Hazardous Wastes Protocol	-	-
Offshore Protocol	-	Signatory
Kyoto Protocol	-	Ratification
Minamata Convention on Mercury	Accession	Signatory
Montreal Protocol	Accession	Ratification
Paris Agreement	Ratification	Ratification
Ramsar Convention	-	Ratification
Rotterdam Convention	Accession	Ratification
Stockholm Convention	Accession	Signatory
United Nations Watercourses Convention	Accession	
United Nations Convention to Combat Desertification	Accession	Ratification
United Nations Framework Convention on Climate Change	Accession	Ratification
United Nations Convention on the Law of the Sea	Accession	-
Vienna Convention	Accession	Ratification

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Chapter 14: Emerging trends and recommendations

14.1 Taking stock

Since 2003, when UNEP issued its last overarching report on the environment of the occupied Palestinian territory, there have been six changes of major significance to the state of the environment.

First, climate change has advanced and is now recognized unequivocally by scientists as “a major driver of environmental change – an inexorable force that can no longer be ignored” (UNEP, 2019). This water-scarce region will be profoundly affected by climate change, which – as the Secretary-General has emphasized – is a “direct existential threat” that is “moving faster than we are” (UNSG, 2018).

In 2003, UNEP noted that global climate change could contribute to environmental stresses affecting the occupied Palestinian territory, such as land degradation, and “magnify the pressure on the water system”. It is now possible to predict temperature increases of up to 2.6°C by mid-century, accompanied by reduced rainfall and more frequent extreme weather events. It is also possible to predict that low-lying areas along the Mediterranean will be affected by storm surges and sea level rise. Climate change will amplify existing risks and create new risks for natural and human systems. These risks are unevenly distributed: people experiencing multiple forms of inequality, marginalization and poverty are most exposed to the impacts of climate change (UNEP, 2019).

Second, satellite images indicate a regional reduction of groundwater storage in this region between 2006 and 2016 (see Figure 29). Several factors may be contributing to this reduction, including over-abstraction, changing precipitation patterns, and higher temperatures. The World Bank and the Food and Agriculture Organization of the United Nations have described a “groundwater boom” which, from the 1970s onwards, “revolutionized agriculture in many countries” in the Middle East and North Africa, but which has had two negative results that affect this region: i) a free-for-all situation in which nimbler or more powerful entities have appropriated water rights; and ii) a “race to the bottom, as no individual has any incentive to conserve the resource, but rather to pump it out before his or her neighbour does” (FAO; WBG, 2018). Although “Establishing a governance framework for groundwater management is exceptionally hard” (FAO; WBG, 2018), further

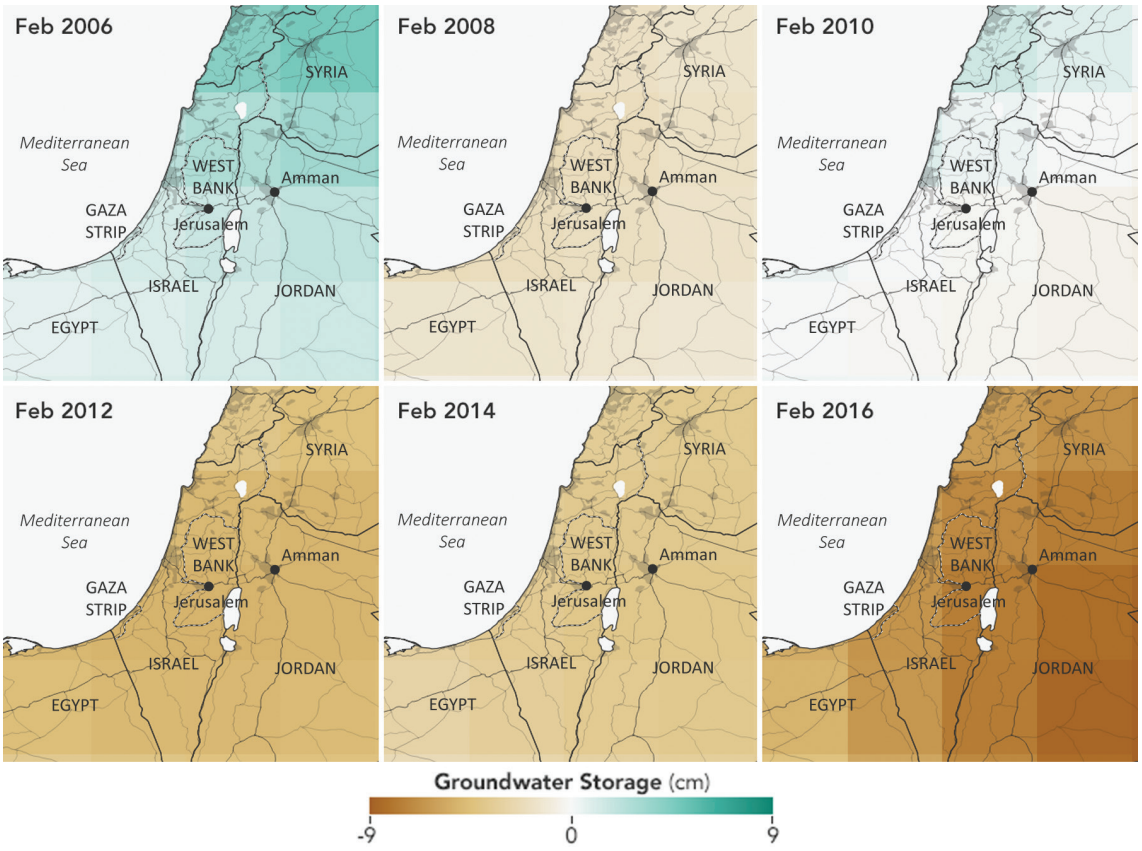

Figure 29
Maps show groundwater availability as observed by the NASA Gravity Recovery and Climate Experiment. Since 2006, the Middle East has experienced a net decrease in groundwater (NASA, 2018).

analysis of changes to the groundwater status, and management options would be warranted in light of the importance of groundwater in this region.

Third, the situation in Gaza has deteriorated as a consequence of conflicts, the Palestinian political divide and closures imposed by Israel. In successive reports, the United Nations Country Team has described a process of "de-development" in Gaza. It is possible to track this process via environmental and public health indicators. The percentage of Gaza residents with access to safe drinking water via the public network has fallen from 98 per cent in 2000 to just 10 per cent in 2014 (UNSCO, 2017). The Coastal Aquifer has been so seriously contaminated by that only four percent of the water extracted is now potable (World Bank, 2018a). The Mediterranean Sea is also seriously polluted by sewage.

Fourth, the increase in both the Palestinian population and the settler population is putting increased pressure on natural resources.
Fifth, the environment of the occupied Palestinian territory is being polluted by electronic waste, with impacts on air, soil, surface and groundwater, on the health of both Palestinians and Israelis.

The sixth major change is a positive one. There have been significant advances in climate solutions that can both strengthen economies and protect the environment. New technologies are already delivering energy at a lower cost than the fossil-fuel driven economy. Water technologies are particularly important in the Middle East region. Israel has, at a domestic level, made major advances in this regard: it has, as described by the Jordanian WANA Institute, "adopted a combination of technological and policy interventions that have allowed it to largely overcome" the pressures associated with extreme water scarcity, "become a leader in irrigated agricultural production and enjoy a version of sustainable water and food security". The WANA Institute is conducting research to assess the extent to which the water management practices employed by Israel can be transferred to Jordan and the occupied Palestinian territory, and to "other economies that share similar

Box 18: occupied Palestinian territory: gaps in environmental data availability

There are significant gaps in environmental data relating to the occupied Palestinian territory. There is no national list for threatened Palestinian fauna due to a lack of comprehensive surveys. Information and research available on microbes, microfauna, mesofauna, and macrofauna, comprising the vast biodiversity of soil, are very limited. Furthermore, there is no systematic recording of soil fertility parameters that would help in evaluating the changes in soil fertility status over time. Accurate assessment of land use trends is also lacking. Reliable data on transboundary waste movements of all types, including hazardous, solid waste and e-waste are not available.

There are also significant data gaps relating to water. Given the critical importance of the Mountain Aquifer, reliable data on withdrawal from all groundwater sources in the West Bank, along with water quality data (other than a limited number of wells), needs to be collected on a regular basis. Further scientific assessment would help to quantify the damage caused by over-abstraction and pollution in the Mountain Aquifer in the West Bank, and Coastal Aquifer in the Gaza Strip. Water losses in delivery systems, and locations of such losses, should be quantified accurately in order to minimize loss. An analysis of the impact of contamination from Wadi Gaza on groundwater pollution levels and marine organisms is not available. More precise estimates of the reduction in water availability due to the impact of climate change also need to be calculated.

environmental endowments" (Gilmont, et al., 2017). The Food and Agriculture Organization of the United Nations has noted the potential in the occupied Palestinian territory "for water harvesting at the macro scale through the construction of dams and large earth ponds" and "high potential to reuse treated wastewater in agriculture". To date, however, "only a few [such] activities have been implemented due to the prevalence of political constraints" (FAO, 2015).

Weak environmental governance has been a persistent challenge. Effective environmental governance is necessary to ensure that policymakers monitor environmental trends consistently, and address sources of environmental degradation promptly. In its 2003 report, UNEP highlighted environmental governance weaknesses, including the "fundamental contradictions and overlaps" that existed between "inherited laws, new environmental laws promulgated by the Palestinian Authority, and Israeli military law". In this 2003 report, UNEP emphasized the need for a "critical review… of all existing laws related to environmental management in the occupied Palestinian territory, and to make recommendations for a viable system of environmental legislation" (UNEP, 2003). There have, unfortunately, been no significant improvements in environmental governance since this report was issued 17 years ago.

Palestinians, Israelis and their regional neighbours are already affected by pollution of the air, soil and water resources of the occupied Palestinian territory. Environmental degradation that occurs in the occupied Palestinian territory cannot be confined to that specific area: ecosystem boundaries "often do not correspond to geopolitical boundaries, so many environmental problems, especially those related to pollution, are often transboundary in nature, such as air pollution, freshwater contamination (surface and groundwater), marine pollution, wastewater, leakages of pollutants, dumping of hazardous and nuclear wastes and species loss" (UNEP, 2019).

In the absence of substantially improved environmental governance, the environmental degradation described in this report looks certain to continue and to accelerate. To reverse these trends, improvements in environmental management and governance are urgently needed. Lack of adequate data and information means that there is currently no efficient nor effective means to monitor the changing state of the environment. Palestinians and Israelis need to address gaps in environmental data, particularly relating to pollution and over-abstraction of watercourses. Lack of a clear delineation of rules and responsibilities leads to a situation in which individuals can exploit governance gaps. Enhancing environmental governance is now critically important to protect natural resources and ecosystems, for current and future generations.

14.2 Overarching recommendations

This report has reviewed environmental challenges, constraints and opportunities in the primary environmental sub-sectors, including terrestrial and marine ecosystems, biodiversity, water, air quality and climate, the urban environment, land degradation and soil contamination. Recommended actions within these sub-sectors are listed at the end of each chapter. All of these recommendations should be implemented: failure to address any aspect of environmental management and protection covered in this report would have serious implications for the future.

Environmental policy development and implementation in the occupied Palestinian territory occurs in a context of uncertainty, division and political impasse. In late 2019, the United Nations Secretary-General expressed his great concern about the "challenges to the international consensus to achieve an end to the occupation and the realization of a negotiated two-State solution of the Israeli-Palestinian conflict" and called once again for "concrete steps in support of ending the occupation and realizing a lasting peace" (United Nations, 2019). In this context, and mindful of constraints to development planning and environmental governance, it is necessary to highlight environmental issues that must be resolved urgently, to prevent irreversible damage to ecosystems and human health. Other issues must be resolved over a longer timeframe – starting now, and aiming for results by the mid-decade, or by 2030.

Priorities for environmental protection and management are described below:

BEFORE 2023:

1. **Tackle severe pollution from waste, especially e-waste and other hazardous waste.** Pollution from the informal e-waste sector and unregulated industries is already affecting human health, particularly the health of children; if uncontrolled, it may have major, long-term health impacts, which cannot be confined to specific geographical areas. Solutions are available and must urgently be implemented, with full cooperation from all stakeholders, in line with target 12.4 of the Sustainable Development Goals.
2. **Scale up efforts to harvest, preserve, treat and reuse water.** Climate change will exacerbate water scarcity, which will in turn impact the Palestinian environment and economy. An urgent, concerted push is required to protect the Coastal Aquifer. Water management faces many challenges: work must accelerate now, across the occupied Palestinian territory, in the following areas:
   a) Enhance rainwater harvesting, where relevant using new technologies, to increase the availability of potable water and water for agriculture;
   b) Reduce losses from the water distribution system;
   c) Significantly reduce pollution of fresh watercourses and the Mediterranean Sea, in line *inter alia* with targets 6.3 and 14.1 of the Sustainable Development Goals;
   d) Increase the reuse of wastewater and educate key stakeholders such as farmers; and
   e) Enhance wastewater treatment in Gaza – without which investment in desalination will not yield full benefits for the people of Gaza.
3. Invest in natural resource-based livelihoods that promote climate resilience and land restoration Initiatives such as the Greening Palestine Programme and use of drought-tolerant fodder crops in rangeland have already contributed to small increases in grassland and tree-covered areas in the West Bank. Broadening such initiatives, and investing in sustainable production, processing and marketing of non-timber forest products such as olives, honey, dates and medicinal plants, would deliver major benefits to people and the environment.
4. **Explore and develop options for boosting the green economy in the occupied Palestinian territory**. From an economic and human security perspective, growth and job creation are of high importance. In seeking to develop a low-carbon, resource-efficient and socially inclusive economy, Palestinians can draw on relatively high levels of tertiary education, and high and growing human development indicators. Initially it will be important to focus on making the traditional sectors more sustainable and cleaner, to allow time for just transition. To facilitate green growth, the Government of Israel needs to lift relevant restrictions.

5. **Address environmental data gaps and shortcomings**
   Agreement on baseline indicators for priority sectors (e-waste and wastewater, among others), and a decision to investigate where data systems are reporting widely varying findings, would help ensure that knowledge about the environment could be fed appropriately into environmental decision-making. UNEP could provide technical support to enhance cooperative knowledge management and scientific data exchange around environmental issues.
6. **Ensure that environmental and climate-related priorities are incorporated into strategic plans**
   Environmental protection and climate change risk management should be integrated fully into the Palestinian national development plans and strategies. International actors, including donors and United Nations entities, also need to ensure that their planning and investment strategies are informed by environmental issues and especially by climate-related risks.

BEFORE 2025:

7. **Establish functioning shared environmental monitoring, management and governance systems**
   It has been evident for well over a decade that the systems for joint environmental management that were established within the 1995 Interim Agreement are insufficient. To protect the environment and natural resources for current and future generations, Palestinians and Israelis need to establish and agree on transparent, evidence-based systems for environmental governance. These systems need to include:
   f) mutually agreed data collection and monitoring provisions;
   g) clarity about which environmental laws apply in the occupied Palestinian territory, and which entities are responsible for enforcing those laws;
   h) processes to ensure coherent urban and land use planning;
   i) effective mechanisms for transparency and accountability; and
   j) processes for engagement and participation by stakeholders regarding environmental governance, including civil society and the private sector.

   To protect the environment, a functioning, shared environmental management and governance system will be necessary – whether or not progress at the broader political level is achieved.
8. **Promote and invest in urban resilience**
   This includes climate resilience, which can be achieved by providing access to safe, affordable, accessible and sustainable transport systems for all (target 11.2 of the Sustainable Development Goals); enhancing air quality and municipal and other waste management (target 11.6); and increasing access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities (target 11.7). It is also critical to focus direct spending on sustainable infrastructure (clean and renewable energy, clean water, sanitation, public transport, waste management and communication).
9. **Work with public and private sector investors to promote sustainable economic development.**
   This includes greening of the agriculture and fishing sector; helping the producers to meet sustainability standards and support for packaging, labelling and marketing; and tackling existing constraints by proactively seeking partnerships from countries and companies interested and able to invest in a green economy.

BEFORE 2030:

10. **Fund and implement climate change adaptation and mitigation measures**
    Adaptation and mitigation measures are described in the Nationally Determined Contributions (NDC) and National Adaptation Plans (NAP) developed by the State of Palestine. Some measures require substantial investment – for example, the transport target includes a 25 per cent shift from private cars to public transport by 2030. Since agriculture is the sector most sensitive to climate variability and change, additional investments are needed in irrigation, improved water efficiency and climate-smart agriculture. Protecting the Gaza coastline from the impacts of sea level rise and upgrading utility systems to include renewable energy sources, will also require additional planning and resources.

11. **Scale up ecosystem restoration**
    Restoration of landscapes and watercourses could deliver major benefits in terms of climate resilience and land productivity. Several policies are proposed, including new technologies in water harvesting, crop rotation, grazing and rotation management, and enhanced use of agroforestry.

Additional, major efforts and investments will be required to ensure that Palestinians achieve the Sustainable Development Goals by 2030. This report provides an agenda for joint action to deliver the environmental dimensions of the 2030 Agenda in the occupied Palestinian territory.

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Annex

Global indicator framework for the 2030 Agenda for Sustainable Development

The 2030 Agenda for Sustainable Development "encourages Member States to conduct regular and inclusive reviews of progress at the national and sub-national levels which are country-led and country-driven". The United Nations Inter-Agency and Expert Group on Sustainable Development Goals Indicators developed the global indicator framework which was agreed upon in March 2017 at the 48th Session of the United Nations Statistical Commission. It was adopted by the General Assembly on 6 July 2017. The list includes 232 indicators that were met with general agreement. However, data on many of these indicators do not exist and countries have developed their own plans and strategies to fill data gaps. The United Nations Statistics Division has developed an e-handbook on Sustainable Development Goals indicators providing guidance on definitions, data collection, computation methods and other methodological considerations. This handbook aims to enable national statisticians to monitor progress made in implementing the Goals, based on data produced by national statistical systems.

Goals, targets and indicators relating to the environment are given in table 37, where the selected relevant indicators for the occupied Palestinian territory are highlighted in bold. Many of these ongoing actions in the environment sector coalesce and enable the achievement of the National Policy Agenda. Table 37 maps environment-related actions in Priority 10 of the National Policy Agenda and highlights some of the local and Sustainable Development Goals indicators for measuring and monitoring.

Table 37: Priority environmental indicators (highlighted in bold) from the United Nations Sustainable Development Goals indicator list. Sources: (SP, 2016); (SP, 2018)

Sustainable Development Goals	National Policy intervention	Indicators
Goal 6: Ensure access to water and sanitation for all	• Expand community access to clean water and sanitation • Expand wastewater management, treatment and reuse	**6.1.1 Proportion of population using safely managed drinking water services** **6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water** **6.3.1 Proportion of wastewater safely treated** 6.3.2 Proportion of bodies of water with good ambient water quality **6.4.1 Change in water-use efficiency over time** **6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources** **6.5.1 Degree of integrated water resources management implementation (0-100)** **6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation** **6.6.1 Change in the extent of water-related ecosystems over time** 6.a.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan 6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management
Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all	• Expand community access to reliable energy • Increase energy efficiency and reliance on renewable energy	**7.1.1 Proportion of population with access to electricity** **7.1.2 Proportion of population with primary reliance on clean fuels and technology** **7.2.1 Renewable energy share in the total final energy consumption** 7.3.1 Energy intensity measured in terms of primary energy and GDP 7.a.1 Mobilized amount of United States dollars per year starting in 2020 accountable towards the $100 billion commitment 7.b.1 Investments in energy efficiency as a percentage of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services

Sustainable Development Goals	National Policy intervention	Indicators
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable		**11.1.1: Proportion of urban population living in slums, informal settlements, or inadequate housing** 11.2.1: Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities 11.3.1: Ratio of land consumption rate to population growth rate 11.3.2: Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically 11.4.1: Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage (cultural, natural, mixed and World Heritage Centre designation), level of government (national, regional and local/municipal), type of expenditure (operating expenditure/investment) and type of private funding (donations in kind, private non-profit sector and sponsorship) **11.5.1: Number of deaths, missing persons and persons affected by disaster per 100,000 people** **11.5.2: Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services** **11.6.1: Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities** **11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)** 11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities 11.7.2: Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months 11.a.1: Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city **11.b.1: Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030** 11.b.2: Number of countries with national and local disaster risk reduction strategies 11.c.1: Proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resource efficient buildings utilizing local materials

Sustainable Development Goals	National Policy intervention	Indicators
Goal 12: Ensure sustainable consumption and production patterns	• Reduce and effectively control pollution and greenhouse gas emissions • Expand solid waste management and recycling • Manage, protect and promote sustainable use and conservation of natural resources (land, water and energy)	**12.1.1Number of countries with sustainable consumption and production (SCP) national action plans or SCP mainstreamed as a priority or a target into national policies** 12.2.1 Material footprint, material footprint per capita, and material footprint per GDP 12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP 12.3.1 Global food loss index **12.4.1 Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement** **12.4.2 Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment** **12.5.1 National recycling rate, tonnes of material recycled** 12.6.1 Number of companies publishing sustainability reports 12.7.1 Number of countries implementing sustainable public procurement policies and action plans 12.8.1 Extent to which (i) global citizenship education and (ii) education for sustainable development (including climate change education) are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment 12.a.1 Amount of support to developing countries on research and development for sustainable consumption and production and environmentally sound technologies **12.b.1 Number of sustainable tourism strategies or policies and implemented action plans with agreed monitoring and evaluation tools** 12.c.1 Amount of fossil-fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels

Sustainable Development Goals	National Policy intervention	Indicators
Goal 13: Take urgent action to combat climate change and its impacts	• Reduce and effectively control pollution and greenhouse gas emissions.	13.1.1 Number of countries with national and local disaster risk reduction strategies 13.1.2 Number of deaths, missing persons and persons affected by disaster per 100,000 people **13.2.1 Number of countries that have communicated the establishment or operationalization of an integrated policy/ strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other)** 13.3.1 Number of countries that have integrated mitigation, adaptation, impact reduction and early warning into primary, secondary and tertiary curricula **13.3.2 Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions** 13.a.1 Mobilized amount of US dollars per year starting in 2020 accountable towards the $100 billion commitment 13.b.1 Number of least developed countries and small island developing States that are receiving specialized support, and amount of support, including finance, technology and capacity-building, for mechanisms for raising capacities for effective climate change-related planning and management, including focusing on women, youth and local and marginalized communities

Sustainable Development Goals	National Policy intervention	Indicators
Goal 14: Conserve and sustainably use the oceans, seas and marine resources		**14.1.1: Index of coastal eutrophication and floating plastic debris density** 14.2.1: Proportion of national exclusive economic zones managed using ecosystem-based approaches 14.3.1: Average marine acidity (pH) measured at agreed suite of representative sampling stations 14.4.1: Proportion of fish stocks within biologically sustainable levels **14.5.1: Coverage of protected areas in relation to marine areas** 14.6.1: Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing 14.7.1: Sustainable fisheries as a proportion of GDP in small island developing States, least developed countries and all countries 14.a.1: Proportion of total research budget allocated to research in the field of marine technology 14.b.1: Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries 14.c.1: Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nation Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources

Sustainable Development Goals	National Policy intervention	Indicators
Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss	• Keep Palestine green (conserve biodiversity, establish nature preserves and expand green spaces)	**15.1.1 Forest area as a proportion of total land area** **15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type** 15.2.1 Progress towards sustainable forest management **15.3.1 Proportion of land that is degraded over total land area** 15.4.1 Coverage by protected areas of important sites for mountain biodiversity 15.4.2 Mountain Green Cover Index **15.5.1 Red List Index** 15.6.1 Number of countries that have adopted legislative, administrative and policy frameworks to ensure fair and equitable sharing of benefits 15.7.1 Proportion of traded wildlife that was poached or illicitly trafficked **15.8.1 Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species** **15.9.1 Progress towards national targets established in accordance with Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011-2020** 15.a.1 Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems 15.b.1 Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems 15.c.1 Proportion of traded wildlife that was poached or illicitly trafficked

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List of acronyms

ABS
Nagoya Protocol on Access and Benefit-Sharing

ACSAD
Arab Center for Studies of Arid Lands and Desertification

AF
Adaptation Fund

AFOLU
Agriculture, Forestry and Other Land Use

ANNU
An Najah National University

APN
Arab Group for the Protection of Nature

ARIJ
Applied Research Institute - Jerusalem

AUWC
Agricultural Union and Working Committee

CAMRE
Council of Arab Ministers Responsible for the Environment

CBD
United Nations Convention on Biological Diversity

CCIVA
Climate Change Impacts, Vulnerability and Adaptation

CIPME
Canadians for Justice and Peace in the Middle East

CMWU
Coastal Municipalities Water Utility

CNG
Compressed natural gas

COGAT
Coordination of Government Activities in the Territories

COM
Council of Ministers

COP
Conference of Parties

CPI
Consumer Price Index

CR
Critically endangered

CSO
Civil Society Organization

DACC
Designated Authority on Climate Change

DNA
Designated National Authority

DPSIR
Driving Forces-Pressures-State-Impacts-Response

DRG
Disaster Response Group

DRM
Disaster Risk Management

DRR
Disaster Risk Reduction

EIA
Environmental Impact Assessment

ENMOD
Environnemental Modification Convention

EN
Endangered

EPME
EcoPeace Middle East

EQA
Palestinian Environment Quality Authority

ERU
Emission reduction units

ESCWA
United Nations Economic and Social Commission for Western Asia

ESIA
Environmental and Social Impact Assessment

ESCOS
Energy Service Companies

ESSEC
Sciences and Seismic Engineering Centre

EU
European Union

EW
Extinct in the wild

EX
Extinct

FAO
Food and Agriculture Organization of the United Nations

FoEME
Friends of the Earth Middle East

GCF
Green Climate Fund

GDCCRR&DM
General Directorate on Climate Change, Risk Reduction and Disaster Management (located in EQA)
– please note that when we refer to the **GDoCC** *in the document we are referring to the GDCCRR&DM*

GDP
Gross Domestic Product

GEF
Global Environment Facility

GEWP II
Gaza Emergency Water Project II

GHG
Greenhouse Gas

GHGI
Greenhouse Gas Inventory

GIS
Geographic Information System

GNI
Gross National Income or Purchasing Power Parity

HDI
Human Development Index

HRC
Human Rights Council

HRW
Human Rights Watch

I&FFA
Investment and Financial Flows Assessment

I&S
Infrastructure and Services

ICJ
International Court of Justice

ICRC
International Committee of the Red Cross

ICZM
Integrated Coastal Zone Management

IDF
Israel Defence Forces

IEF
Implied Emission Factor

IHME
Institute for Health Metrics and Evaluation

ILO
International Labour Organization

ILS
Israeli new shekel

IMoFA
Israel Ministry of Foreign Affairs

INCR
Initial National Communication Report

INSS
Institute for National Security Studies

IOLR
Israel Oceanographic and Limnological Research

IPCC
Intergovernmental Panel on Climate Change

IPPU
Industrial processes and product use

IsDB
Islamic Development Bank

IUCN
International Union of Conservation and Nature

IWA
Israel Water Authority

IWRMP
Integrated Water Resources Management Plan

JEEC
Joint Environmental Experts Committee

JI
Joint Implementation Mechanism

JMP WHO / UNICEF
Joint Monitoring Programme (JMP) for Water Supply and Sanitation

JSETs
joint supervision and enforcement teams

JV
Jordan Valley

JWC
Israeli-Palestinian Joint Water Committee

LDCF
Least Developed Countries Fund

LDN
Land Degradation Neutral

LECRDS
Low Emissions Climate – Resilient Development Strategies

LGUs
Local Governing Units

M&E
Monitoring and Evaluation

M&I
Municipal and Industrial

MAP
Mediterranean Action Plan

MCSD
Mediterranean Commission on Sustainable Development

MDC
Birzeit University Media Development Centre

MEA
Multilateral Environmental Agreement

MNA
Ma'an News Agency

MoA
Ministry of Agriculture

MoEA
Ministry of Environmental Affairs

MoEHE
Ministry of Education and Higher Education

MoEP
Ministry of Environmental Protection

MoFA
Ministry of Foreign Affairs

MoFP
Ministry of Finance and Planning

MoH
Ministry of Health

MoLG
Ministry of Local Government

MoN
Ministry of National Economy

MoP
Ministry of Planning

MoPWH
Ministry of Public Works and Housing

MoT
Ministry of Transport

MoU
Memorandum of Understanding

MRV
Measurement, reporting and verification

NAD
Negotiations Affairs Department

NAMA UNFCCC
Nationally Appropriate Mitigation Actions

NAP
National Adaptation Plan

NAPA UNFCCC
National Adaptation Plans of Action

NAPs UNCCD
National Action Programmes

NBSAP CBD
National Biodiversity Strategy and Action Plan

NCSA
National Capacity Self-Assessment

NDA
National Designated Authority

NDC
Nationally Determined Contribution

NDP
National Development Plan

NDRMC
National Disaster Risk Management Centre

NDRMP
National Disaster Risk Management Platform

NEAP
National Environment Action Plan

NECCF
National Environment and Climate Change Fund

NFP
National Focal Point

NGEST
North Gaza Emergency Sewage Treatment

NGO
Non-Governmental Organisation

NIE
National Implementing Entity

NIPD
Net Israeli Population Density

NPP
Net Primary Productivity

NPPD
Net Palestinian Population Density

NRDP
National Reform and Development

NRW
Nonrevenue water

NSI
New Israeli Shekel.

NSP
National Spatial Plan

NSSWM
National Strategy for Solid Waste Management

NT
Near Threatened

NWC
National Water Carrier

OCHA
United Nations Office for the Coordination of Humanitarian Affairs

OFP
Operational Focal Point

oPt
Occupied Palestinian Territory

Oslo I
Declaration of Principles on Interim Self-Government Arrangements

Oslo II
Interim Agreement on the West Bank and the Gaza Strip

PA
Palestinian Authority

PALAST
Palestine Academy for Science and Technology

PARC
Palestinian Agricultural Relief Committee

PCBS
Palestinian Central Bureau of Statistics

PCRS
Palestine Red Crescent Society

PEC
Palestinian Energy & Environment Research Center

PEIS
Palestinian Environmental Information System

PENRA
Palestinian Energy and Natural Resources Authority

PERSGA
Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden

PHG
Palestinian Hydrology Group

PLC
Palestinian Legislative Council

PLO
Palestine Liberation Organization

PLWSC
Palestinian Land and Water Settlement Commission

PM
Particulate Matter

PNA
Palestinian National Authority

PNCCD
Palestinian National Committee for Combating Desertification

PoA
Programme of Activities

POICA
Palestinian Observatory of Israeli Colonization Activities

POPs
Persistent Organic Pollutants

PPU
Palestine Polytechnic University

PRCS
Palestine Red Crescent Society

PRSP
Poverty Reduction Strategy Paper

PV
Photovoltaic

PWA
Palestinian Water Authority

R
Rare

RE
Renewable energy

REC
Recovery

RR
Risk Reduction

SAP
Strategic Action Programme

SASPARM
Support Action for Strengthening Palestine capabilities for seismic Risk Mitigation

SC
Semi-coastal

SCCF
Special Climate Change Fund

SDG
Sustainable Development Goal

SGP
Small Grants Program

SIDA
Swedish International Development Cooperation Agency

SIDS
Small Island Developing States

SME
Small- to medium-scale enterprises

SOC
Soil Organic Carbon

SOP
Standard operating procedure

SP
State of Palestine

SWOT
An analysis of Strengths, Weaknesses, Opportunities, and Threats

TSP
Total Suspended Particles

UN
United Nations

UNCCD
United Nations Convention to Combat Desertification

UNCTD
United Nations Conference on Trade and Development

UNCT
United Nations Country Team

UNDAC
United Nations Disaster Assessment and Coordination

UNDESA
United Nations, Department of Economic and Affairs

UNDP
United Nations Development Programme

UNDP/PAPP
United Nations Development Programme/Programme of Assistance to Palestinian People

UNE
United Nations Environment

UNEA
United Nations Environment Assembly

UNEP
United Nations Environment Programme

UNFCCC
United Nations Framework Convention on Climate Change

UNFPA
United Nations Population Fund

UNGA
United Nations General Assembly

UNICEF
United Nations Children's Fund

UNISDR
United Nations Office for Disaster Risk Reduction

UNRWA
United Nations Relief and Works Agency

UNSC
United Nations Security Council

UNSCO
Office of the United Nations Special Coordinator for the Middle East Peace Process

UNSG
United Nations Secretary General

USAID
United States Agency for International Development

USD
United States Dollar

VC
Village Council

VR
Very Rare

VU
Vulnerable

WAB
Western Aquifer Basin

WASH
Water, Sanitation and Hygiene

WBG
World Bank Group

WCMC
World Conservation Monitoring Centre

WHO
World Health Organization

WMO
World Meteorological Organization

WSRC
Water Sector Regulatory Council

WWTP
Wastewater treatment plant

UN environment programme