

Ripple Effects

Exploring the environmental impact of
Israeli settlements' wastewater discharge



Ripple Effects: exploring the environmental impact of Israeli settlements' wastewater discharge

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Acronyms

COGAT: Coordinator of Government Activities in the Territories
COD: Chemical Oxygen Demand
CORINE: Coordination of Information on the Environment
CFU/G: Colony-Forming Units per gram
E. coli: Escherichia coli
GDP: Gross Domestic Product
GIS: Geographic Information Systems
HDI: Human Development Index
IHL: International Humanitarian Law
IHL: International Human Rights Law
IPCC: Intergovernmental Panel on Climate Change
IZ: Industrial Zone
LRC: Land Research Center
MCM: Million Cubic Metres
NDC: Nationally Determined Contribution
NPA: National Priority Areas
OCHA: United Nations Office for the Coordination of Humanitarian Affairs
oPt: occupied Palestinian territory
PA: Palestinian Authority
PPM: Parts per million
TSS: Total Suspended Solids
UN: United Nations
UNFCCC: United Nations Framework Convention
UWWTD: European Union Urban Wastewater Treatment Directive
WHO: World Health Organisation

Executive summary

The unlawful discharge of untreated or inadequately treated wastewater by Israeli settlements in the West Bank is a serious and growing threat to the environment, with profound implications for affected Palestinian communities and the enjoyment of their human rights.

Through the use of geographic information systems, chemical and biological analysis, and socio-economic surveys, focused on two research sites in the West Bank, this study reveals the nature and extent of this threat. Water samples taken from Palestinian agricultural areas in Wadi Shakhit in the Hebron governorate, and in the vicinity of the Immanuel industrial zone in the Salfit and Qalqilya governorates, show severe contamination by faecal coliforms as well as high levels of organic particulate matter, indicating substantial pollution from human sewage or animal waste. Elevated nitrate levels were also detected, with the potential to cause eutrophication in water systems, and groundwater contamination.

Similarly, soil samples from both sites showed high levels of faecal coliforms, including *E. coli*, indicating potentially serious contamination. Further, soil samples contained traces of heavy metals such as copper, chromium, and nickel, suggesting the release of industrial waste with wastewater discharges. High sodium levels were also found in the soil, which are known to disrupt soil structure and nutrient absorption, and can drastically hinder crop growth.

Such contamination can have serious and immediate implications for agricultural productivity, public health and biodiversity. In addition, the widespread discharge of settlement wastewater and its associated harm—including the contamination of critical water systems and precluding practices such as crop diversification—threatens to further erode the already limited capacity of Palestinians to adapt to the intensifying effects of climate change.

In an already stunted West Bank economy with stagnant growth and a typical monthly income which falls far short of the cost of living, the impact on Palestinian farmers of such discharges is acute. Respondents report a sharp decline in income resulting both from reduced crop yields and the difficulty of selling produce associated with sewage contamination. Combined with significant increases in costs associated with the tending of their lands, for many Palestinians living in the shadow of settlements, agriculture is no longer economically viable.

Beyond the economic impact, the pollution of these areas has profound social and cultural implications for Palestinians. The curtailing of farming practices disrupts deep-rooted connections between the people and their land, threatening cultural traditions and community bonds that have been cultivated over generations. This weakening of ties to the land threatens the community's cultural identity, and leaves

agricultural areas exposed to a heightened risk of expropriation through Israeli declarations of untended lands as ‘state land’, which are then used for settlement construction and expansion.

The discharge of wastewater therefore carries not only environmental and economic threat, but also contributes to Israel’s ongoing annexation of West Bank territory and the forcible transfer of Palestinians. Alongside other unlawful and coercive practices associated with Israel’s settlement project, such as the destruction of Palestinian property or acts of settler violence, wastewater discharge serves to drive Palestinians from their lands, and its address should be a matter of priority for the international community.

In particular, third states and international organisations must require Israeli authorities to immediately act to ensure that Palestinian communities, lands and resources are protected against the effects of disposal of waste originating from settlement. In conjunction, urgent and meaningful efforts—beyond mere condemnation—must be taken to ensure that Israel ceases and reverses its illegal settlements project.

Israeli settlements' environmentally harmful practices and impacts

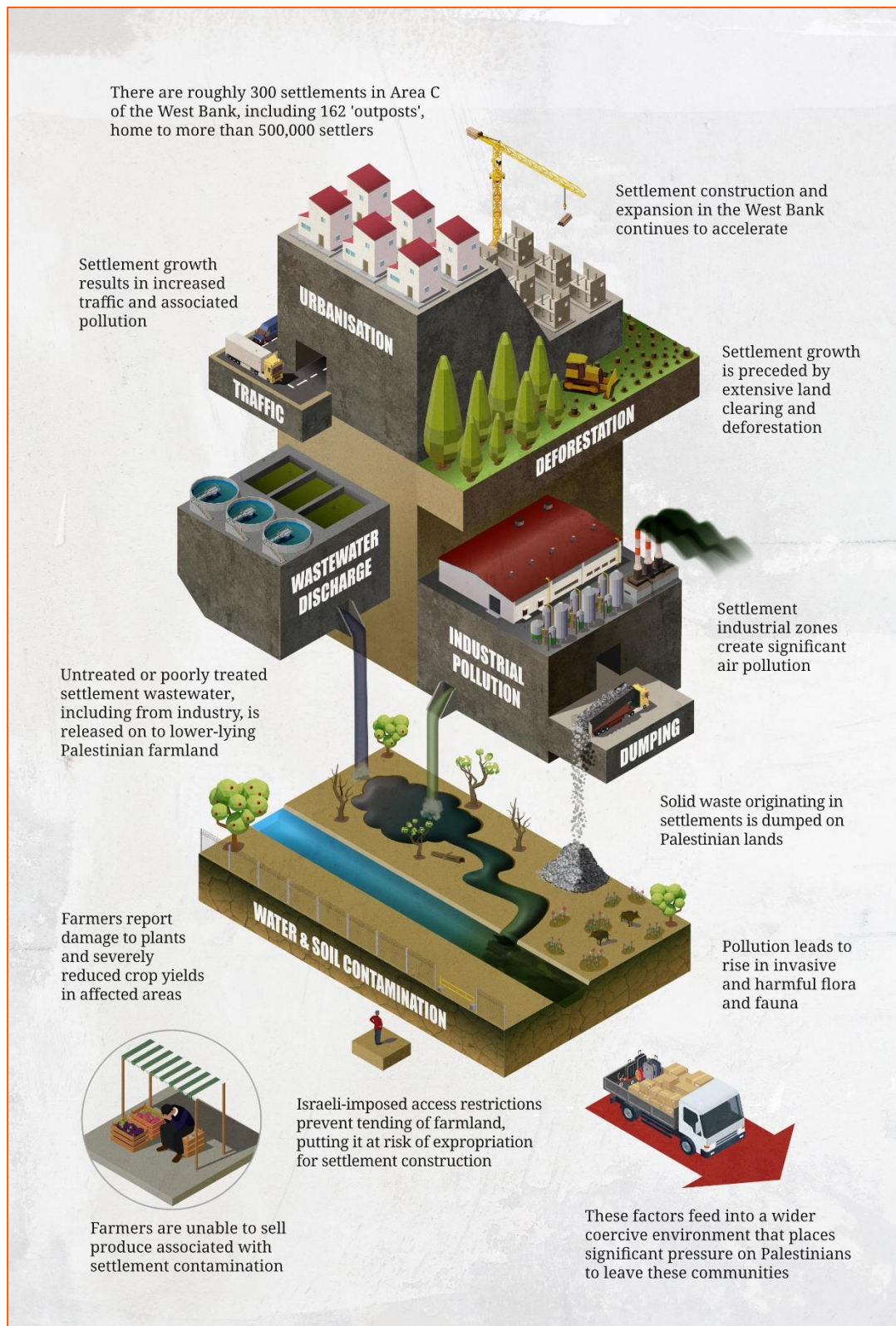


Illustration: Simon Randles/NRC

1 Introduction

Entering the 57th year of Israel's occupation of Palestinian territory and its settlement project, the international discourse on the latter has typically focused on the illegality of Israeli settlements and, increasingly, acts of violence perpetrated by their residents. This is understandable, given the scale of the settlement project, the severity of the legal violation it represents and the intensification of settler violence during the project's lifespan.

However, while these issues undoubtedly demand sustained attention and urgent address, it must be recognised that the severe harm resulting from settlements is not limited to population transfer, annexation of territory, or acts of physical or psychological violence.

One example of such harm is the profound impact that settlements have on the surrounding natural environment and, in turn, on Palestinian communities forced to live in their shadow. This harm is multifaceted. Fertile tracts of land that once sustained Palestinian agriculture have been transformed into sprawling concrete neighbourhoods, clanking industrial zones, and their associated civilian and military infrastructure. Swathes of native trees have been bulldozed as part of widespread deforestation, soil has been compacted and degraded, and countless natural habitats destroyed.

As the Government of Israel accelerates the transfer of its citizens into the occupied West Bank, the settler population rises and settlements grow to accommodate the increase. With this continued construction and expansion—undertaken with resources unlawfully extracted from the occupied territory—comes a rapid increase in the settlement project's environmental footprint.

This report considers one specific act within this footprint: the discharge of untreated or inadequately treated settlement wastewater onto Palestinian lands. Though this receives far less attention than settlement growth figures or settler attacks, the harm resulting from this practice is severe and pervasive.

This report is not intended as a comprehensive environmental impact study, but a review of the experiences of two Palestinian communities living with the effects of wastewater discharge. In exploring this issue, quantitative, empirical data is analysed to understand the nature of the threat posed, combined with qualitative data collection to map the human impact.

Specifically, the report investigates how wastewater discharge can shape the daily lives of farmers, landowners and residents; exacerbate already declining socio-economic conditions; and erode their relationship with their ancestral lands. These impacts are then situated within the broader contexts of Israel's ongoing forced displacement of Palestinians, its undermining of Palestinian

capacity to withstand climate change, and the associated detrimental impacts on the human rights of Palestinians.

In drawing attention to the environmental and socio-economic impact of settlements, this report calls upon stakeholders to understand the destructive, multi-layered effects of the settlement project, and to prioritise and actively pursue its dismantling.

2 Settlements: background and legality

2.1 Settlement growth

Israel's settlement project has been relentlessly expanded since the beginning of Israel's occupation of the West Bank, including East Jerusalem, and the Gaza Strip (as well as the Syrian Golan Heights) in 1967.

Despite the Oslo Accords—signed in the mid-1990s between Israel and the Palestinians, and ostensibly intended to pave the way to a durable peace agreement—settlement construction in the West Bank has persisted, and in many periods, intensified, reflecting the unfailing support of various Israeli governments. This support has come in a range of forms, including the creation and maintenance of a deeply [discriminatory planning system](#), financing of vast settlement construction projects, granting of financial incentives for Israeli citizens to relocate to settlements, and the provision of security, often through the Israeli military. Even during periods of a claimed "freeze" on new construction, exceptions are commonly made by the Government of Israel for what is termed "[natural growth](#)."

As of September 2023, there were approximately [300 Israeli settlements across the West Bank](#), including 14 in East Jerusalem. At least 162 of these settlements were so-called 'outposts', illegal even under Israel's own domestic law.

According to settler groups, as of January 2024 there were some 517,000 settlers in the West Bank (not including the 340,000 living in East Jerusalem) compared to 435,000 in 2018; a growth rate during this period of 15 per cent.ⁱ Based on current trends, by 2035 this figure is predicted to rise to more than 706,000, resulting in a total settler population exceeding one million.ⁱⁱ

2.2 The legal status of settlements

Israeli settlements are widely viewed as illegal under international law, primarily on the basis that they violate [Article 49](#) of the Fourth Geneva Convention, which holds that "[t]he Occupying Power shall not deport or transfer parts of its own civilian population into the territory it occupies." Such transfers are a serious breach of international humanitarian law, and prosecutable as war crimes.

The position that Israeli settlements in the West Bank are unlawful has found consistent and widespread support from the international community, including through a number of UN resolutions addressing the issue. UN Security Council [Resolution 242 of 1967](#) emphasises the "inadmissibility of the acquisition of territory by war," reflecting a foundational principle in international law that any territorial gains achieved by use or threat of force are without legal merit.

UN Security Council [Resolution 446 of 1979](#) explicitly states that "the policy and practices of Israel in establishing settlements in the Palestinian and other Arab territories occupied since 1967 have no legal validity." Similarly, UN Security Council [Resolution 2334 of 2016](#) recalled "the inadmissibility of the acquisition of territory by force," and condemned "all measures aimed at altering the demographic composition, character and status of the Palestinian Territory occupied since 1967, including East Jerusalem, including, *inter alia*, the construction and expansion of settlements, transfer of Israeli settlers...".

To this end, the construction of Israeli settlements and a variety of practices associated with their construction—including the destruction of Palestinian property and forcible transfer of Palestinian communities— should be viewed not only as unlawful in its own right, but also as a primary tool in Israel's ongoing annexation of West Bank territory.

3 The scale of the settlement waste threat

3.1 Wastewater discharge

The discharge of settlement wastewater represents a serious threat to the West Bank natural environment and to affected Palestinian communities.

Countries with higher levels of development, often characterised by factors such as economic expansion, increased globalisation, and urban growth, typically [exhibit greater per capita resource consumption and, critically, waste production](#).

As of 2022, Israel ranked just one place behind the United States of America in the [Human Development Index](#) (HDI), a metric compiled by the UN Development Programme to quantify a country's "average achievement in three basic dimensions of human development: a long and healthy life, knowledge, and a decent standard of living." HDI ranking is calculated by aggregating a country's scores in a wide range of indicators, including GDP per capita, exports and imports, multidimensional poverty index, and income inequality.

To this end, it has been reported that settlers in the West Bank "[produce similar amounts of wastewater to the Palestinian population, despite being outnumbered more than six-to-one](#)".

According to the [Palestinian Central Bureau of Statistics](#), Israeli settlements in the West Bank produce some 40 million cubic meters of wastewater annually.ⁱⁱⁱ However, many Israeli settlements [lack adequate waste treatment facilities](#). In 2009, [B'Tselem](#) reported that one third of settlements were not connected to wastewater treatment facilities, while the remainder employed less modern treatment methods than those used in Israel, and suffered regular malfunctions or were shut down completely. Meanwhile, the wastewater from the roughly 160 'outposts' which lack formal access to public infrastructure, is unlikely to be adequately treated, or treated at all.

In 2018, the [Palestinian Central Bureau of Statistics](#) calculated that 90 per cent of all settlement wastewater (roughly 35 million cubic meters, or the equivalent of 14,000 Olympic-size swimming pools each year) was untreated and discharged onto Palestinian lands.

Moreover, this is a threat that scales to settler population. As this population grows, and wastewater continues to go inadequately treated, so too does the threat.

In addition, the effects of these discharges are compounded by the physical location of settlements, which are typically situated on high ground, for reasons including

surveillance and territorial dominance.^{iv} This leaves neighbouring, lower-lying Palestinian communities, their agricultural lands and natural water systems particularly vulnerable as these discharges naturally flow downhill.

3.2 Solid waste dumping

Though not the focus of this report, the dumping of settlements' solid waste in the West Bank represents a notable environmental threat and should be viewed in conjunction with the discharge of wastewater.

Similar to wastewater, Israeli settlements generate significantly more solid waste per capita than Palestinians. [According to research undertaken by Thöni & Matar](#) in 2019, West Bank Palestinians generate an average of 0.9 kg of solid waste per person per day, compared to 1.9 kg generated by settlers. Each day, Israeli settlements are considered to generate roughly 1,200 tons of solid waste. According to a 2020 [report](#) by the UN Environment Programme, “solid waste from settlements contributes to the strain on West Bank solid waste management capabilities”, while the transfer of solid waste originating both from settlements and within Israel to [illegal dumping sites](#) in the West Bank creates a host of environmental and health threats.

The increased creation and illegal dumping of solid waste also runs contrary to Israel's own Nationally Determined Contribution (NDC), submitted to the United Nations Framework Convention (UNFCCC) in July 2021. In their NDC, Israel committed to a national waste strategy that reduces greenhouse gas emissions from solid waste by at least 47 percent by 2030, through an overall total reduction of solid waste, as well as a complete ban on untreated solid waste, such as some of the waste being produced from settlements. To be in accordance with its own NDC, Israel should have a strategy to minimize solid waste from settlements, for as long as they are to remain in the West Bank, and ensure that all solid waste is properly treated in Israeli facilities. They must also ensure that illegal dumping practices are strictly prohibited. The amount and treatment of solid waste from settlements must also be included in all of Israel's calculations outlined in their NDC.

3.3 Settlement industrial zones

As of 2019, according to [Who Profits](#), there were 19 Israeli industrial zones (IZs) located either inside or in close proximity to settlements in the West Bank. Almost all settlements and IZs are designated as Israeli National Priority Areas (NPA), affording individuals and companies in these locations access to a range of financial incentives. These include preferential loans, grants for infrastructure, rent deductions, tax breaks, and compensation for income loss due to European Union customs.^v

Besides monetary benefits, businesses based in West Bank IZs also enjoy logistical advantages, such as an extensive and well-connected road network, ensuring quick access to Israeli commercial hubs. For instance, travel from certain West Bank IZs to

Tel Aviv is faster than from some industrial parks located inside Israel, illustrating the strategic location advantage of these settlements.^{vi}

In addition, companies located in settlement IZs are not subject to the same environmental protection laws or regulations as counterparts based in Israel. For instance, [neither the Clean Air Law of 2008, nor the Environmental Treatment of Electrical and Electronic Equipment and Batteries Law of 2012 are currently applicable to operations based within settlement IZs](#). This has been strongly criticised by settler associations, who complain of their quality of life being negatively affected and [warn](#) of West Bank industrial zones becoming “a paradise for polluters.” Meanwhile, Palestinian authorities have no jurisdiction over such zones or the businesses situated within them, and cannot therefore impose or enforce Palestinian environmental laws or regulations on their operations.

The lack of regulation has drawn to settlement IZs an array of industrial and manufacturing operations which generate potentially harmful waste products, including operations with effects deemed [too harmful to be situated in Israel](#). For example, in 1983, chemical factories were relocated from within Israel to an area near Tulkarm in the West Bank (an area which would be later known as the Nitsanei Shalom Industrial Park) following complaints by Israeli citizens about the pollution generated by these facilities.^{vii} According to the [Applied Research Institute – Jerusalem](#), polluting practices stemming from IZs include emission of noxious fumes and discharges of untreated or inadequately-treated industrial wastewater on to Palestinian lands. Some of these discharges have been found to have “a high concentration of chemical materials”, which “leach[ed] into the soil and groundwater resources”.^{viii}

As will be highlighted in the following case studies, the impact of such practices on Palestinian lands and communities can be disastrous.

4 Case studies

4.1 Methodology

To assess the impact of settlement wastewater discharge on Palestinian lands and communities, this report utilises field research conducted by the [Land Research Center](#) (LRC) during the period 1 May 2023 to 31 October 2023.

The research centred on two locations: Wadi Shakhit, located in the Beit Ummar municipality within the Hebron governorate, and the periphery of the Immanuel settlement in the Salfit/Qalqilya governorates. These locations were selected for being representative of the environmental threats resulting from the discharge of settlement wastewater and the associated socio-economic impacts on Palestinian communities.

In undertaking this research, a multi-layered data collection methodology was adopted, consisting of:

1. **A land cover analysis** that was undertaken by LRC's Geographic Information System team, utilising the Coordination of Information on the Environment (CORINE) classification system. This analysis involves the capturing, processing and interpreting of high-resolution data and other relevant information to discern and map distinct land features, such as vegetation, water bodies, urban structures, and agricultural lands.
2. **A water, soil, physicochemical and microbiological analysis** that was undertaken to identify both the nature of any environmental contamination and its extent. Water samples were taken at surface level, while soil samples were taken at depths between 0-70cm, ranged from 200-1,000 grams in mass and were performed at varying distances from the observed source of contamination. These samples were then sent to the Environmental Analysis Unit at Birzeit University for physicochemical and microbiological analysis.
3. **Socio-economic survey** tools that were employed to collect data and testimonies from residents affected by settlement wastewater discharge. Specifically, a questionnaire was issued to residents, landowners and farmers in the affected areas to gather information on the economic and social implications of these practices,^{ix} while semi-structured interviews allowed for the sharing of interviewees' personal experiences and capturing of more nuanced insights. Combined, these tools allowed for identifying and elaborating upon a variety of harmful effects of settlement pollution.

4.1.1 Study Site One: Wadi Shakhit

CORINE land cover for Beit Ummar/Wadi Shakhit (2022/Level III)

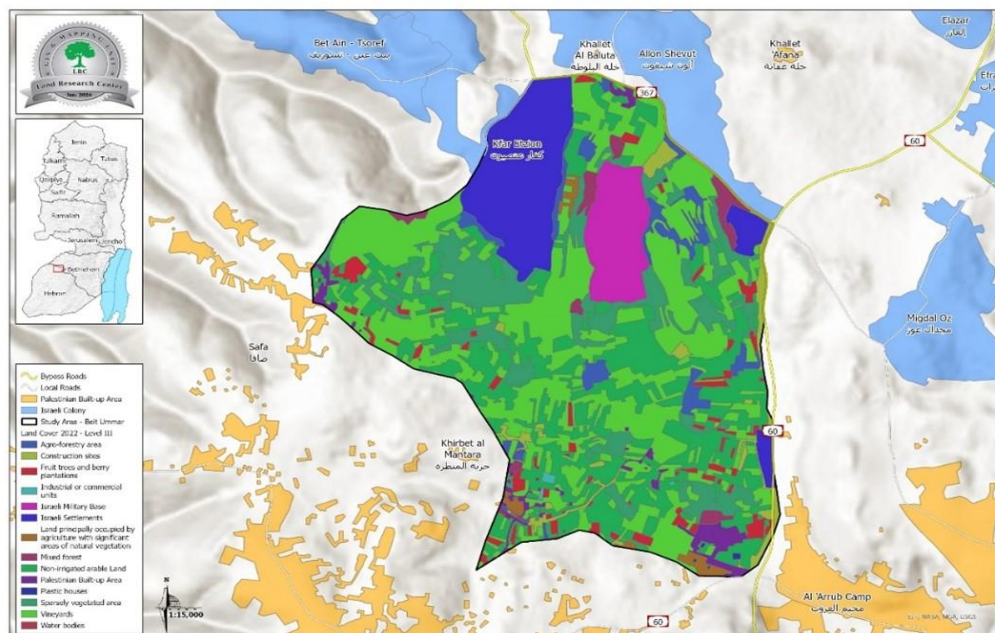


Image: LRC

The designated study area for site one ('Wadi Shakhit site') covers an area of 6,162 dunums (6,162,000 m²) in the area of Beit Ummar, a Palestinian town of some 20,000 people in the Hebron Governorate in the southern West Bank. According to CORINE analysis, within this area of study, agricultural areas (3,084 dunums) account for the majority of land cover, followed by artificial surfaces (1,284 dunums), consisting of settlement buildings and infrastructure (667 dunums), Israeli military infrastructure (312 dunums), construction sites (155 dunums) industrial or commercial units (eight dunums), and Palestinian built-up areas (142 dunums). In addition, forests and semi-natural areas account for 1,065 dunums.

Field research focused specifically on Wadi Shakhit, located to the northeast of Beit Ummar, and covering an area of 500 dunums (500,000 m²). known for its fertile agricultural lands, for generations Palestinian farmers in Wadi Shakhit have grown almonds, olives and, more recently, grapes, irrigated by the nearby Marina spring.

However, settlement construction began in the area soon after the commencement of Israel's occupation of the West Bank, with Wadi Shakhit bordered to the north by Kfar Etzion (established in 1967) and to the east by Alon Shvut (established in 1970). In the subsequent decades this construction accelerated and there are now some 14 settlements in the immediate area,^x comprising the 'Gush Etzion' settlement bloc, with an estimated total settler population of over 110,000 as of December 2023.^{xi}

Located on the southern boundary of Kfar Etzion is a wastewater treatment plant which, according to analysis of satellite imagery, appears to consist of, at a minimum, two clarifier tanks, which allow for the settling of solid particles within the water; two sludge drying beds or lagoons, used to dewater sludge that remains after treatment; and two retention ponds (roughly 5,500m² and 2,000m² respectively), used typically for the storage of treated wastewater before it's reused, released, or further treated. This treatment plant receives wastewater from surrounding settlements, [including Efrat, which has some 35 kilometres of sewage pipes alone.](#)

According to Palestinian residents of the area, this treatment plant periodically releases polluted water into the Wadi Shakhit valley, with serious consequences for agriculture and health.

Affected farmers report that such releases have taken place since the 1990s, but have notably increased in frequency since 2009, since which time no year has passed without such a release. These events are now common in the spring (April-May), when grapes leaves are being picked, and in August-September, when grapes are being harvested.^{xii}

During site observations following a complaint from farmers of a release of polluted water, field researchers reported the discharged water to be black in appearance, with a strong foul odour. This discharge ran visibly for roughly 300m from the point of release, polluting an area of some 100 dunams (100,000 m²).

Wadi Shakhit sampling area

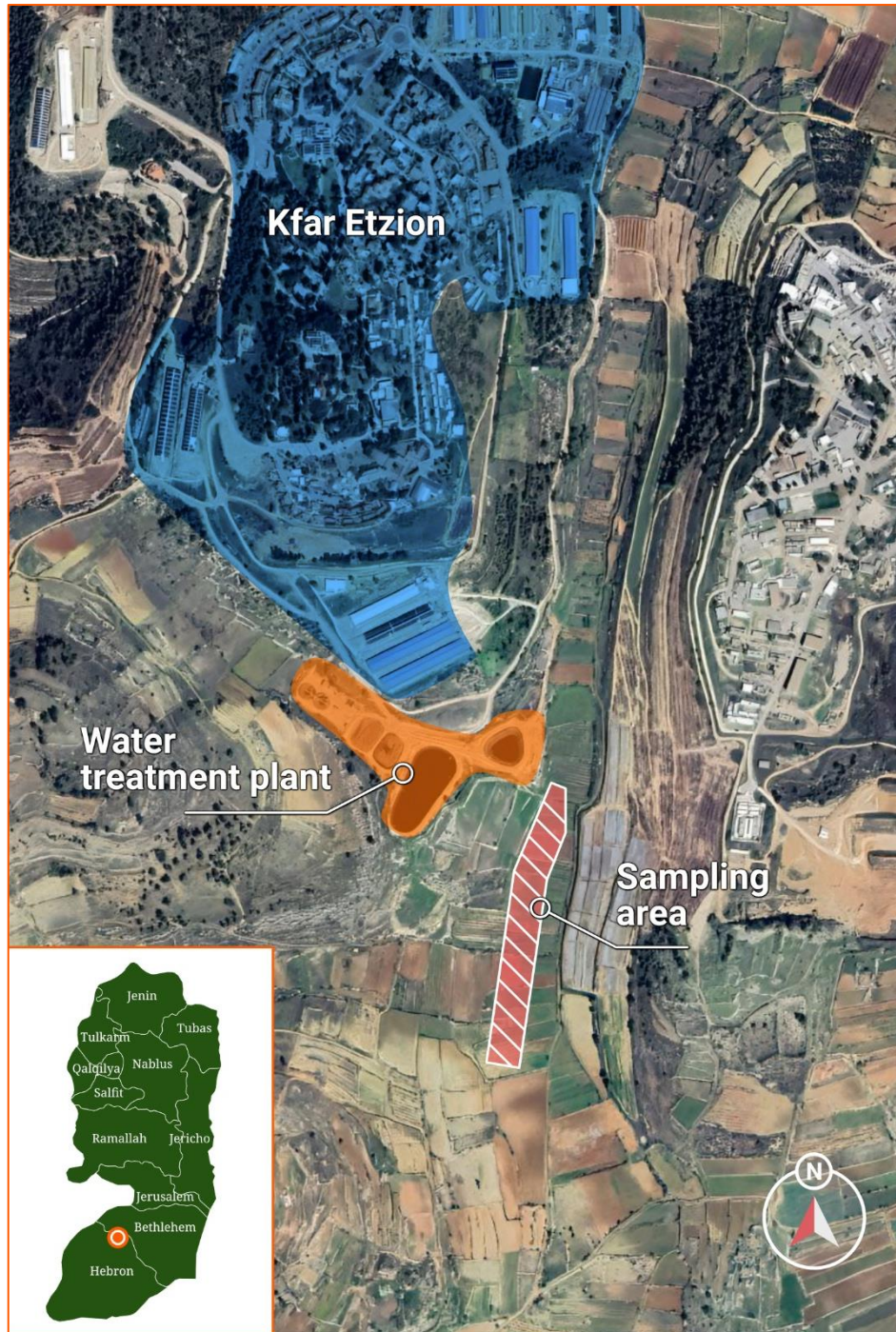
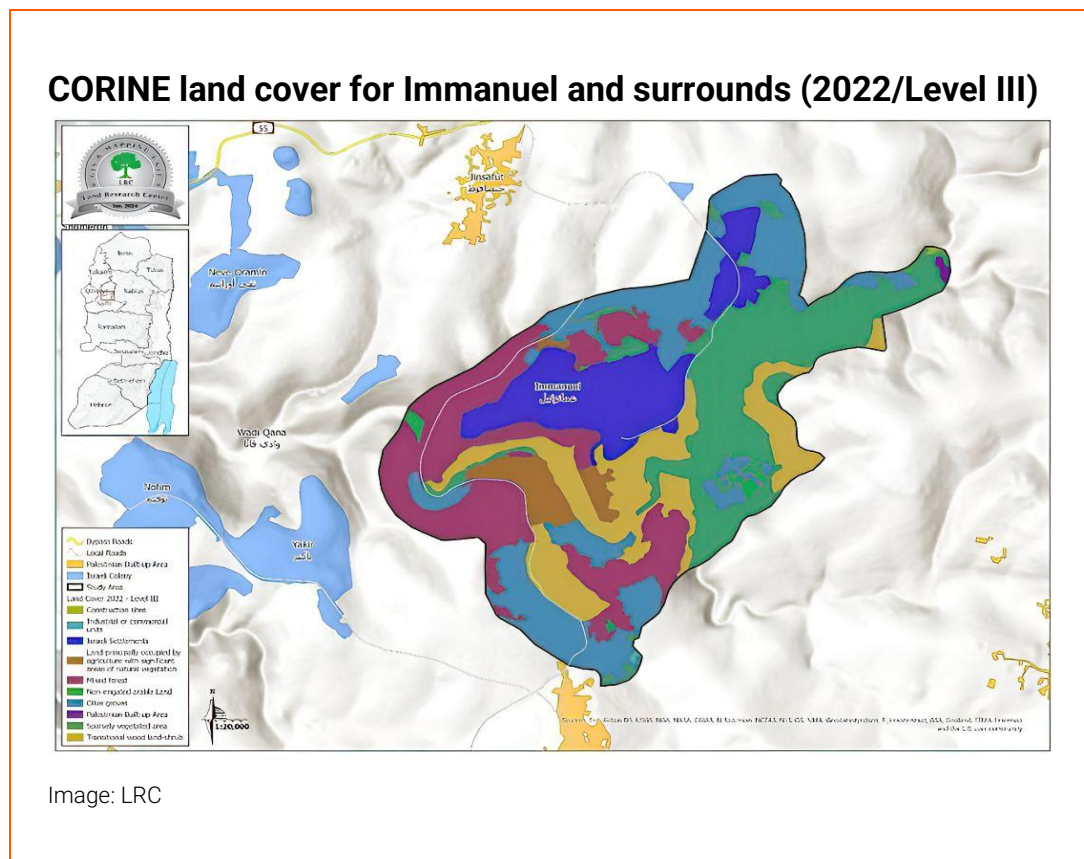


Image: Google Earth. Design: Simon Randles

4.1.2 Study Site Two: Immanuel industrial zone



The designated study area for site two ('Immanuel site') covers an area of 9,532 dunums (9,532,000 m²) in the region surrounding the Immanuel industrial zone, located roughly one kilometre northeast of the residential settlement of the same name, spanning the Qalqilya and Salfit governorates in the northern West Bank. According to CORINE analysis, within this area of study, agricultural areas (2,516 dunums) account for the majority of land cover, followed by forests (5,593 dunums), semi-natural areas (2,516 dunums), and artificial surfaces (1,422 dunums), consisting of settlement buildings and infrastructure (1,390 dunums), industrial or commercial units (eight dunums), construction sites (seven dunums) and Palestinian built-up areas (17 dunams).

Established in the late 1980s on the outskirts of the Wadi Qana area, the Immanuel industrial zone has steadily expanded to cover an area of roughly 600 dunams (600,000 m²), expropriated from the Palestinian communities of Dirstiya, Amatin, and Al-Fondouq. According to residents, this expansion accelerated following Israel's passing clean air legislation in 2008, with businesses moving their operations to the West Bank (where the legislation does not apply) seemingly to take advantage of the less restrictive legal landscape regarding emissions. Today, a variety of businesses are situated within the industrial zone, including an aluminium factory and aluminium workshops; carpentry workshops and factories; a pickling plant; plastic factories; and a recycling plant for solid plastic waste.

In the shadow of the industrial zone, and the focus of this study, are agricultural lands consisting of non-irrigated arable areas and olive groves, as well as significant areas of natural vegetation. The total area of agricultural lands in the study site is 2,516 dunums (2,516,000 m²). The resulting environmental threat posed to these lands by the Immanuel industrial zone are multifaceted.

First is the dumping of solid waste in the vicinity of the industrial zone. According to Palestinian residents in the area, and supported by field investigations by the Land Research Center, solid waste—often containing toxic materials—originating from the industrial zone as well as from residential settlements, is dumped on Palestinian land. Over time, this waste ferments and decomposes, producing toxic leachate which contaminates soil and water sources.

Second, and the focus of this study, is the release of wastewater originating from the industrial zone.

Residents report discharges of seemingly untreated wastewater at a rate of four or five times per year directly on to agricultural lands via an outlet pipe set into a retaining wall of the industrial zone. According to residents, such discharges include wastewater with high saline content from a pickling factory, as well as oils, dyes and other hazardous substances. During site observations, field researchers reported the discharged water ran visibly for at least 2,800m from the point of release, polluting an area of some 120 dunams (120,000 m²), with agricultural lands belonging to Palestinian the village of Jinsafut particularly affected.

Immanuel sampling area

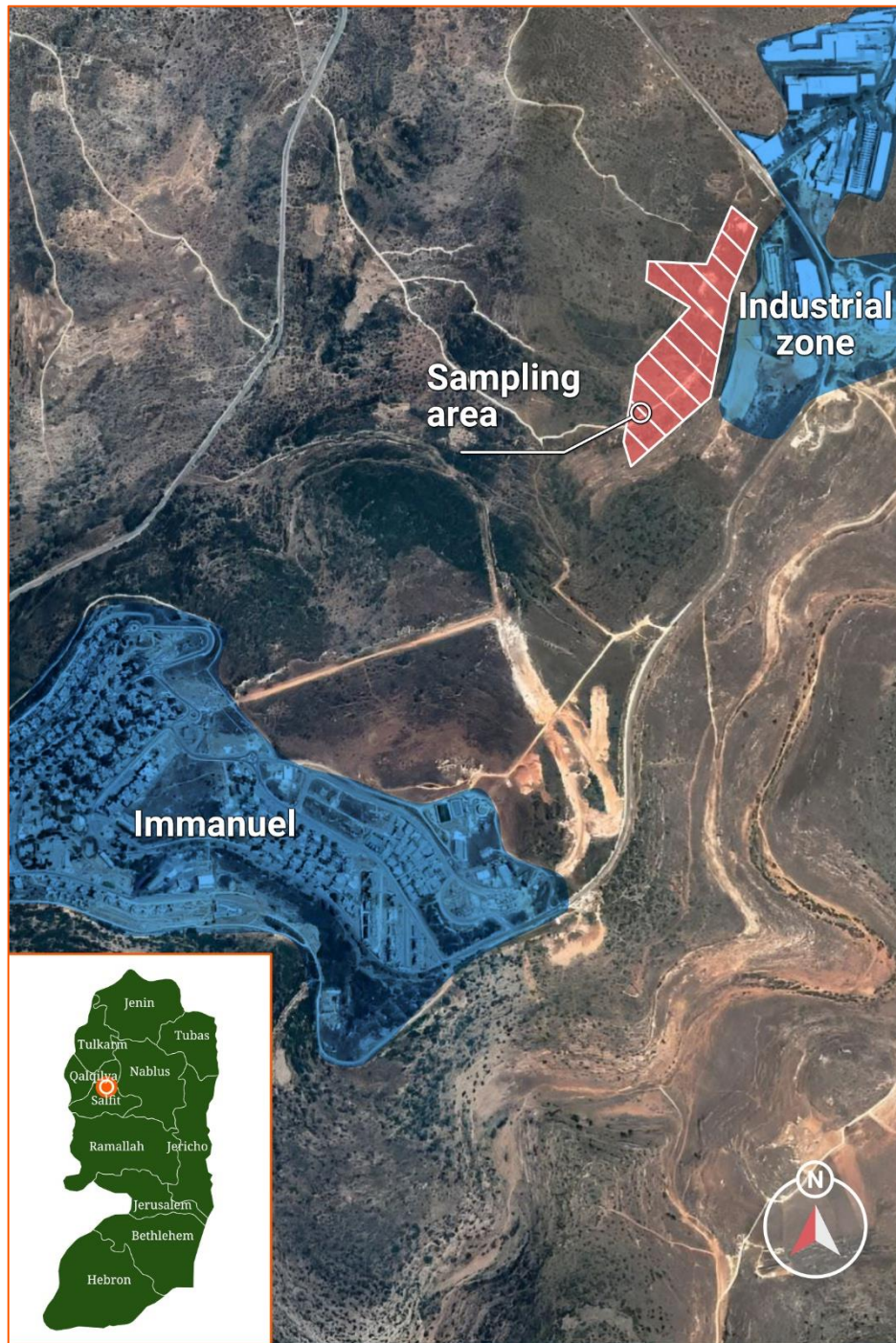


Image: Google Earth. Design: Simon Randles

4.2 Chemical and biological analysis

4.2.1 Contamination of water systems

Testing of water samples from both the Wadi Shakhit and Immanuel sites for the presence of faecal coliforms, and specifically **Escherichia coli (E. coli)**, returned results of ‘Too Many to Count’, meaning that **the number of colonies (usually bacteria) present per 100 millilitre sample was so high that they could not be accurately counted.**^{xiii} Faecal coliforms are a subgroup of total coliform bacteria specifically associated with the faeces of warm-blooded animals. Their presence in water is a [strong indication of recent sewage or animal waste contamination](#), and also serves as a warning indicator for the presence of potential pathogens.

Elevated levels of faecal coliforms therefore represent a public health concern. Certain strains of E. coli can cause serious illnesses, including severe diarrhoea, kidney failure and even death in some situations. In Wadi Shakhit, the highest indicators of E. coli were found closest to the wastewater discharge point, indicating their origination from this point.

In addition, samples revealed alarmingly high **Chemical Oxygen Demand (COD)** levels. COD provides an estimate of the [amount of organic pollutants in a water sample](#), helping to **gauge the effectiveness of wastewater treatment** and to assess the health of natural water bodies. The [European Union Urban Wastewater Treatment Directive](#) (UWWTD) sets a guideline level of 125 mg/l for discharges from urban wastewater treatment plants.^{xiv} **In Wadi Shakhit, the COD level was recorded at 312 mg/l, with a level of 557 mg/l at the Immanuel site.**



Photo: LRC

Wastewater discharged from Kfar Etzion flows through Palestinian agricultural lands in Wadi Shakhit (October 2010).

Similarly, water samples showed very high levels of **Total Suspended Solids (TSS)**, a common parameter measured in the analysis of wastewater and water quality monitoring. TSS refers to **the total quantity of particulate matter suspended in water**, and may include a variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. In **Wadi Shakhit, the TSS level was recorded at 960 mg/l, with the Immanuel site recording a level of 8,809 mg/l.** For comparison, the UWWTD provides guideline levels for discharged wastewater of between 35 and 60 mg/l.^{xv}

In addition, the **Immanuel site samples showed nitrate levels of 39 mg/l,** compared to UWWTD guideline levels of between 10 and 15 mg/l.^{xvi} **Elevated nitrate levels can lead to eutrophication—the excessive growth of algae due to an abundance of nutrients**—with potentially serious consequences for water oxygen levels, as well as for wildlife. Nitrates are highly soluble, and when discharged into surface water bodies, they can percolate down and [contaminate groundwater sources](#). This is of particular concern in areas where groundwater is a primary source of drinking water.

In summary, the results of the above chemical and biological analysis of water samples from both sites are consistent with the release of untreated or inadequately treated wastewater, which is entirely unfit for agricultural purposes. It can also be confidently concluded, on the basis of the available evidence, that such discharges are attributable to Israeli settlements.

4.2.2 Contamination of soil

Untreated or inadequately treated wastewater not only contaminates natural water systems but also agricultural lands. This can occur through direct contact between a contaminated water feature, such as a stream or pool, and the soil, as well as potentially through the use of irrigation channels or pipes which draw from a contaminated source.

In initial samples taken from Wadi Shakhit, a strong presumptive positive result for the presence of *E. coli* was returned in soil taken from the point of discharge, with reducing presumptive positive results returned out to a distance of 500 metres. At the Immanuel site, a strong presumptive positive result for the presence of *E. coli* was returned in soil taken at the point of discharge, though not indicated in samples taken close to this point, nor in samples taken at distances of 1,000 and 1,500 metres.

In subsequent laboratory analysis, as with the water samples, **soil samples from both the Wadi Shakhit and Immanuel sites returned faecal coliforms results of Too Much to Count.** Meanwhile, specific testing for *E. coli* in soil samples from Wadi Shakhit returned results of up to 1,950 colony-forming units per gram (cfu/g), and from Immanuel of 2,250 cfu/g.

Although the baseline amount of *E. coli* in agricultural soils can vary significantly, depending on a range of factors including presence of livestock and fertilisation practices, it is notable that at both sites *E. coli* was strongly indicated in soil closest to the wastewater discharge point, but less so (or not at all) further from this point.

This, combined with the significant presence of the same faecal coliforms in both water and soil, indicates that settlement wastewater is the primary source of contamination at both locations.

Additionally, at both locations, preliminary analysis of soil samples revealed the **presence of a variety of heavy metals, including copper, manganese, chromium and nickel**. This suggests that industrial effluents may also have been discharged in addition to sewage, as has long been reported by Palestinian landowners. The potential implications of such practices are serious and far-reaching, including threats to water systems, soil structure, crop growth and human health. For this reason, further study into the scale of discharge of untreated or inadequately treated industrial wastewater originating from Israeli settlements, and its impact on Palestinian communities, is essential.

Furthermore, soil samples from both sites revealed sodium concentrations of up to 94 parts per million (ppm). Concentrations of sodium in soil [exceeding 40ppm can affect soil structure and nutrient uptake, and severely impact on crop performance](#). This aligns with claims made by farmers at the study sites that evaporation of discharged wastewater had left behind substantial salt deposits, which in turn had impacted crop growth and yield.

4.2.3 Impact on agricultural lands

In both research sites, settlement wastewater—which flows for significant distances across the sites—has killed off vegetation and rendered significant areas unusable for agricultural purposes.

According to LRC, in the Wadi Shakhit site, the **cultivable area for grape vines in the affected region has decreased from 2,771 dunams (2,771,000 m²) in 2010 to 2,041 dunams (2,041,000 m²), representing a 26 per cent reduction**.

Grapevines in the contaminated zone show signs of stunted growth, scorched leaves, and poor fruit quality.

“As settlers began diverting water into the valley's lands, the trees started to decline in their production. Grape leaves became unsuitable for use. About three years ago, I harvested only 10 boxes of grapes from my land. This year, I left the fruit on the trees because it was damaged.”

Abu Mashur, Wadi Shakhit

Similarly, farmers and landowners in the affected area at the Immanuel site complain of **severe reduction in olive tree productivity (up to 70 per cent in some cases)** compared to the pre-discharge era.

“Wastewater has extensively flooded my land. A salt layer now covers the soil, significantly impacting the quality of the produced oil from my olive groves. Each olive tree used to yield no less than 25 kilograms of olives, but today production has dropped by half.”

Ahmed Othman Youssef Bashir, Jinsafut, close to Immanuel IZ

“Due to the wastewater, I lost 13 fruitful olive trees that were 40 years old, producing large quantities of olive oil. We tried planting olive seedlings several times to replace those destroyed by wastewater, but wild boar destroy the seedlings and hinder their growth, in addition to the salinity of the soil, which is no longer suitable for production.”

Abdel Hakim Mahmoud Hussein Eid, Jinsafut



Photo: LRC

Palestinian vines in Wadi Shakhit sit in a pool of wastewater discharged from the Kfar Etzion settlement (March 2018)

4.2.4 Ecosystem disruption

At both sites, **invasive plant species were observed in the contaminated areas**, namely *Inula viscosa*, *Datura stramonium*, *Phragmites australis* and *Ricinus communis*. Due to their adaptability, including their tolerance of soils with high pH levels and rich in nitrogen, all of these species are often found close to sources of pollution. Notably, **these four species are not typically found in olive groves or close to grapevines and were not detected outside of the polluted areas**. It therefore seems likely their presence is attributable, at least in part, to settlement-related pollution.

"Due to the spread of large and harmful weeds, including many types that were not originally present, I now have to regularly spray the land.^{xvii} Not all areas can be ploughed, and even those that can now need more than one ploughing and multiple weed control operations due to the extensive and accelerated growth. This has become a burden, and I can no longer afford the high and numerous costs."

Thabet Bashir, Jinsafut

Of particular concern is the presence of *Datura stramonium*, also known as **Jimsonweed**, a toxic plant known to contain tropane alkaloids such as scopolamine and atropine, primarily in its seeds, flowers, and roots. Historically, in certain cultures, *Datura* has been used both for its hallucinogenic effects and as a poison. The concentration of these toxic compounds can vary depending on the plant's age, growing conditions and prevailing weather factors. *Datura* can be **fatal to livestock if ingested in sufficient quantities**, with [possible symptoms](#) including neurological disturbances, digestive issues, visual impairments, increased heart rate, and elevated body temperatures.



Photo: LRC

Signs of soil disturbance and damage to vegetation caused by wild boars in Palestinian agricultural lands near Immanuel industrial zone

In addition, the presence of *Ricinus communis*, commonly known as the **castor bean plant**, poses a **threat to livestock (and humans if consumed)** due to its high ricin content, especially in its seeds. Ingestion can lead to [symptoms](#) including drooling, abdominal pain, diarrhoea, and elevated heartbeat. In severe cases, ingestion can cause seizures or even death. While the seeds have the highest ricin concentration, other parts of the plant are also toxic. The plant is also [extremely allergenic](#). Rating 10 out of 10 on the Ogren Plant Allergy Scale, the plant produces

large amounts of pollen, leading to potential respiratory allergic reactions, especially in individuals with asthma. Furthermore, direct skin contact with its leaves may also result in rashes.

Mosquitos and other insects have reportedly proliferated at both sites, seemingly drawn to the wastewater, while at the Immanuel site, residents report **severe disturbance and damage to the land and olive trees caused by an invasive species of wild boar.**^{xviii} Attracted to habitats with dense vegetation and heavy moisture, such as those subject to wastewater discharge, these animals—sometimes weighing up to 100 kilograms—are highly destructive to the natural environment due to foraging on young plants, upturning soil, and even the dislodging of large boulders. Palestinian farmers near the Immanuel IZ claim that residents of nearby settlements have released wild boar onto their lands with the intention of hampering agriculture.

4.2.5 Socio-economic impact

Based on the results of the socio-economic survey performed as part of this research study, the economic impact for local Palestinians of settlements' discharge of wastewater has been severe.

The Palestinian economy is in poor health, with [projected reduced growth and real GDP growth stagnant](#). According to U.S Department of State, the [average daily wage for West Bank Palestinians is 37 USD](#), equating to some 740 USD per month.

For the majority of survey respondents, these figures were even lower, with a reported main source of monthly income in the region of 500 USD. In the present economy, amid rising costs of living, this level of income cannot sustain an adequate standard of living, and many Palestinians are therefore forced to seek additional employment. In rural areas, agriculture is a natural choice for achieving supplementary income and has been so for multiple generations.

For example, in Wadi Shakhit, prior to the regular discharge of settlement wastewater on to their lands, survey respondents reported annual supplementary income from agriculture in the region of 1,100-1,300 USD. However, this figure is now reported to have fallen to 400-500 USD; a reduction of between 50-70 per cent.

This collapse in agricultural income is driven not only by reduced crop yields apparently stemming from the contamination of water and soil, but also a steep decline in the marketability of harvested crops due to their association with this contamination.

“Due to the polluted water discharged by settlers into our lands, it has become difficult for us to sell our grape products. If I were to pick some grapes to sell in the market, traders and citizens would not buy them from me. Everyone knows that there are polluted waters coming from the settlements into Wadi Shakhit.”

Abu Odeh, Wadi Shakhit

“There is a significant issue in marketing olive oil in the neighbouring villages and towns. No one wants to buy oil knowing its source is the valleys near the wastewater stream.”

Ahmed Othman Youssef Bashir, Jinsafut

Meanwhile, the costs associated with maintaining agricultural lands have soared, due in part to Israeli-imposed importing fees and restrictions on equipment and materials, [particularly those identified as 'dual-use'](#).^{xix} According to survey respondents, costs associated with ploughing, weeding, pruning and harvesting were typically in the region of 300-400 USD per season. However, a majority of respondents report these costs as having now doubled. These rising costs are compounded by the need for greater land reclamation efforts resulting from heightened weed growth.

Combined with severe reduction in crop yield and marketability, these factors increasingly render agriculture economically unviable for Palestinians living in settlement wastewater catchment areas.

“I can no longer afford the high and numerous costs, especially with the decline in oil quality, decreased demand, and reduced production.”

Thabet Bashir, Jinsafut

“Previously, pesticides cost me 340 shekels (85 USD), but today, I have to pay 900 (226 USD) shekels for pest control operations. I no longer have a viable source of additional income to support my family in light of these environmental disasters.”

Ahmed Othman Youssef Bashir, Jinsafut

“What we gain from the land no longer brings us any benefit. It doesn't even cover the expenses of the tractor fuel when I plough the land.”

Abu Mashur, Wadi Shakhit

As agriculture becomes increasingly untenable as a source of income, residents of affected communities are forced to seek alternative employment, including [leaving the area in search of work](#).

“Farming in Wadi Shakhit has become unprofitable. Due to the contaminated water and the decline in production, and the market's reluctance to buy products from Wadi Shakhit, [...] I started looking for additional work to support my family. I currently work as a taxi driver. I work day and night to try to compensate for what I have lost.”

Mohammad Younis Mahmoud Sabarna, Wadi Shakhit

- a. Social and cultural implications of inability to undertake traditional agriculture.

In destroying the crops and the marketability of agricultural produce, the flow of settlement wastewater into Palestinian communities like Wadi Shakhit and those on the periphery of the Immanuel IZ has also eroded ancient connections between Palestinians and their lands. Agricultural traditions which have been passed down from generation to generation now hang in the balance.

“This has pushed me, my wife, and my children to distance ourselves a little from the land. My wife, who used to accompany me in the field work, hasn't visited our land in years due to the harm caused by polluted water from the settlements.

Even my sons and grandsons have given up on working the land because farming in Wadi Shakhit has become unprofitable."

Abu Mashur, Wadi Shakhit

"My sons and grandsons no longer believe in working the land because the polluted water that settlers release almost every year has made our efforts worthless."

Abu Odeh, Wadi Shakhit

The central role of agriculture in the Palestinian national identity, as well as in the Palestinian concept of *sumud*, or steadfastness, is [well-documented](#). The annual olive harvest, for example, is a community affair. Friends, relatives and neighbours gather to pick and process the fruits in an act of bonding. It connects Palestinians not just to one another, but to the land beneath their feet; a fundamental component of both community and resilience-building in rural areas. In short, the undermining of Palestinian agriculture is an attack on the social and cultural fabric of Palestinian life.

Moreover, as well as creating an economic environment which forces Palestinians to leave rural areas in search of work, a weakening of Palestinian connections to agricultural lands can lead to these areas going untended. This then places them at risk of being [expropriated by Israel as 'state lands'](#) and then allocated for further settlement construction.

In this way settlements feed their own growth, and the discharge of wastewater should be viewed as another unlawful corollary of the settlement project—alongside [destruction of Palestinian homes](#) and [settler attacks](#)—which drives Palestinians from their lands.

5 Settlement wastewater discharge and international law

As well as posing considerable environmental, health and socio-economic threats, the discharge of wastewater by Israeli settlements in the West Bank is also of significant concern from an international law perspective.

As the occupying power (OP), Israel has binding obligations under both international humanitarian law (IHL) and international human rights law (IHRL), which apply concurrently to the situation in the oPt.^{xx} The discharge of untreated or inadequately treated settlement wastewater engages a number of these obligations.

5.1 International Humanitarian Law

[Article 43](#) of the Hague Regulations of 1907 requires the OP to take all necessary measures to ensure public order and safety in the occupied territory, while respecting, unless absolutely prevented, the laws in force in the country. In essence, Article 43 imposes a [duty of good governance](#) on the OP, which would include the need to provide basic services such as clean water and sanitation. In failing to prevent discharge of untreated or inadequately treated wastewater—along with the attendant health and environmental impacts on the local population—Israel may be said to be in breach of this obligation.

[Article 56](#) of the Fourth Geneva Convention obligates the OP to ensure and maintain, to the fullest extent of the means available to it, and with the cooperation of national and local authorities, among other things, public health and hygiene in the occupied territory. Israel's failure to prevent the discharge of untreated or inadequately treated settlement wastewater has clear negative implications for public health and hygiene and may therefore constitute a violation of this obligation.

Under [Article 55](#) of the Hague Regulations of 1907, an OP should act as a custodian of the occupied territory, safeguarding its natural resources. Under the principle of 'usufruct', an OP can make use of and benefit from such resources in its administration of the occupied territory but is prohibited from depleting or destructively exploiting these resources. The destructive effects of discharge of

untreated or inadequately treated settlement wastewater into water systems and onto Palestinian lands may therefore constitute misuse and over-exploitation of the West Bank's resources.

[Article 53](#) of the Fourth Geneva Convention prohibits destruction of property by the OP unless it is absolutely necessary for military operations. The contamination of agricultural lands and freshwater sources due to the discharge of untreated or inadequately treated settlement wastewater may be considered as a form of destruction of property.

5.2 International Human Rights Law

International Human Rights Law (IHRL) guarantees a broad set of rights relevant to the discharging of wastewater and dumping of solid waste originating from Israeli settlements.

For instance, the right to a healthy environment is widely recognised among states.^{xxi} Bundled within this right are multiple [substantive elements](#), including the right to clean air; access to safe water and adequate sanitation; non-toxic environments; and healthy ecosystems and biodiversity. Contamination of Palestinian water sources and agricultural lands resulting from settlement wastewater and solid waste dumping appear to clearly engage a number of these substantive elements.

In addition, the right encompasses the following procedural elements: access to information; public participation; and access to justice. The structural exclusion of Palestinian participation in public policy matters pertaining to Area C of the West Bank, as well as the reported inability of affected farmers and landowners to receive reparations for damages caused, appear to violate these procedural rights.

In addition, the right to health, enshrined in Article 12 of the International Covenant on Economic, Social and Cultural Rights, emphasises creating conditions devoid of significant health risks. As affirmed by the UN Committee on Economic, Social and Cultural Rights in its [General Comment 14](#), "...the right to health embraces a wide range of socio-economic factors that promote conditions in which people can lead a healthy life, and extends to the underlying determinants of health, such as food and nutrition, housing, access to safe and potable water and adequate sanitation [...] and a healthy environment." Contamination of water and pollution of land resulting from settlement waste management propagate diseases, undermine food production and severely affect the well-being of local communities.

The right to water and sanitation is derived from the right to an adequate standard of living, health, and well-being, enshrined in Article 25 of the [Universal Declaration of Human Rights](#) and Article 11 of [International Covenant on Economic, Social and Cultural Rights](#). The right to water and sanitation is widely recognised as a distinct right due to its critical importance for human survival and dignity. Contamination of Palestinian water sources and the broader natural environment due to discharge of settlement wastewater and solid waste dumping represents a serious infringement of this right.

The right to adequate housing is derived from the right to an adequate standard of living, health, and well-being, enshrined in Article 25 of the Universal Declaration of Human Rights and Article 11 of the International Covenant on Economic, Social and Cultural Rights. The right to housing means far more than four walls and a roof, it means the ability to live in peace, security, and dignity.

This right is defined by seven key standards including the availability of services, materials, facilities, and infrastructure, which cannot be satisfied if safe drinking water and adequate sanitation is not available due to contamination. Another key standard is the adequacy of location. Location can never be deemed adequate if is proximate to polluted sites or in the immediate proximity of pollutions sources. The impacts, therefore, of settlement wastewater and solid waste dumping, is increasingly threatening Palestinians' enjoyment of the right to housing.

6 Undermining Palestinian resilience to the effects of climate change

6.1 Vulnerability and resilience to the effects of climate change: an overview

In the context of climate change, the [Intergovernmental Panel on Climate Change](#) (IPCC) defines ‘vulnerability’ and ‘resilience’ as follows:

Vulnerability: “The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.”

Resilience: “The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure, while maintaining the capacity for adaptation, learning, and transformation.”

Vulnerability and resilience to the effects of climate change are therefore derived from a variety of factors, including not only environmental concerns, but also social characteristics, such as a community’s cohesion and knowledge base, as well as economic and political landscapes. Further, in some cases, hard limits to adaptation—defined by the IPCC as a situation where [“adaptive actions become infeasible to avoid risks”](#)—may arise as a result of biophysical, institutional, financial, social or cultural barriers.

As global temperatures rise and all states and populations face climate-related vulnerability of varying nature and scale, the building of such resilience becomes of critical importance. However, policies and practices stemming from Israel’s prolonged occupation of the West Bank, including the continued expansion of its illegal settlements project, severely undermine—if not entirely curtail—the ability of Palestinians to adequately adapt to the reality of climate change.

6.2 West Bank climate trends, hazards and impacts

According to [Carnegie Endowment for International Peace](#) “The countries of the Middle East, especially Arabic-speaking ones, are among the world’s most exposed states to the accelerating impacts of human-caused climate change, including soaring heat waves, declining precipitation, extended droughts, more intense sandstorms and floods.”

In the case of the oPt, the outlook is particularly alarming. Presently, the West Bank's climate is predominantly Mediterranean, with [distinct seasonal variations](#). Winter months see largely mild temperatures ranging from 8°C to 15°C, accompanied by rainfall, while summer months are hot and arid, with temperatures typically between 20°C to 30°C, and exceeding 35°C in areas like the Jordan Valley.

However, according to the [World Health Organisation](#) (WHO), under a global high emissions scenario, by the end of this century the mean annual temperature in the West Bank is projected to rise on average by 4.4°C. During the same period and under the same high emissions scenario, approximately 60 per cent of days on average will be defined as ‘hot’, while total annual precipitation is anticipated to decrease by roughly 30 per cent on average. As a result, the frequency and/or intensity of dry episodes and drought events is predicted to increase, alongside a decrease in the frequency and/or intensity of wet events.

The potential impacts of these hazards are dire.

For instance, with predicted increases in temperature come increased potential for heat-related deaths. According to the WHO, under a high emissions scenario, “heat-related deaths among the elderly (65+ years) are projected to rise to about 50 per 100,000 by 2080”,^{xxiii} compared to the 2022 rate of two per 100,000: an increase of 2,400 per cent. In addition, the [implications for Palestinian agriculture are numerous](#), including damage to crops resulting from more frequent temperature extremes; exacerbated water scarcity; proliferation of pests and pathogens; loss of biodiversity; and shortened or postponed growing seasons.

6.3 Occupation-derived challenges to Palestinian resilience to climate change

6.3.1 Structural limitations on the exercise of power by the Palestinian Authority

The organisation primarily responsible for developing Palestinian resilience to the effects of climate change is the Palestinian Authority (PA); the quasi-governmental body established following the signing of the Oslo Accords. Under the Accords, Israel was to transfer a wide array of administrative powers and responsibilities, including for ‘Area C’ of the West Bank—accounting some two-thirds of West Bank territory—to the PA over a period of five years. This has not yet occurred. [As noted by the PA](#), the result is that “the [Palestinian environment ministry] shares the same responsibilities as any ministry of environment, but with its actual authority compromised by elements of the Israeli occupation.”

These elements include:

- The near impossibility of undertaking Palestinian construction projects in Area C, including climate adaptation-related infrastructure.^{xxiii}
- Severe restrictions placed on the ability to allocate existing West Bank natural resources.
- Severe restrictions placed on the ability of PA officials, staff or contractors to move within the West Bank, including some 645 Israeli-imposed checkpoints and physical obstacles.

In addition, the impact of Israel’s occupation on the Palestinian economy is catastrophic. As just one example, according to a [2022 report](#) by UNCTAD, the cost of restrictions on Palestinian development in the 30 per cent of Area C which Israel has *not* allocated for settlement construction amounts to 25.3 per cent of West Bank GDP, with a cumulative loss during 2000-2020 of 50 billion USD. Meanwhile, the contribution to the Israeli economy from Israeli settlements in both Area C and East Jerusalem is estimated at 30 billion USD per year, or cumulatively during 2000-2020 at 628 billion USD.

This hollowing out of the West Bank’s economic potential and the broader undermining of the Palestinian economy significantly hampers the ability of the PA to build climate change resilience. For instance, the ability to invest in large-scale projects to combat the effects of climate change or to fund research, innovation or communication programs is severely restricted.

6.3.2 Water scarcity

Access to water is pivotal to resilience against climate change. As well as being essential to sustaining life, reliable water access underpins agriculture, health, and socioeconomic stability. Ensuring sustainable water resources fosters adaptive

capacities, allowing societies to better navigate and mitigate the multifaceted challenges posed by changing climate conditions.

Control of the West Bank's water resources has formed a central component of Israel's occupation. Two months after the Six-Day War of 1967, Israel issued [Military Order 92](#), vesting all powers under the applicable Jordanian law relating to water in the hands of an Israeli official appointed by the Israeli military Area Commander. In the same year, through Military Order 158, Israel imposed restrictions on Palestinian water access, severely limiting the ability of Palestinians to develop water infrastructure. Combined, Military Orders 92 and 158 placed all of the water resources under Israeli control, and Israel has used these resources for its own benefit ever since, including to support settlements and their residents.

According to [Carnegie](#), the mid-1990s Oslo Accords and extended negotiations between the Palestinians and Israel have enabled Israel to further dominate transboundary waters, disregarding growing Palestinian needs. The result has been Israel's appropriation of [80 per cent of West Bank groundwater](#). This issue is compounded by an ageing Palestinian water grid which results in an estimated [one-third](#) of all water purchased by the PA from Israel being lost to leakage, while [little of the one-quarter of Palestinian wastewater which is treated is then reused](#).

[B'Tselem](#) reports that as of May 2023, the average water consumption for West Bank Palestinians stands at 82.4 litres per person/day. However, in communities which are not connected to the water network, average consumption falls to 26 litres per person/day. In contrast, the average daily consumption by Israeli settlers is 247 litres per person.

The [WHO recommends minimum daily water consumption](#) for direct human consumption and hygiene needs is between 50 and 100 litres per person/day. With Palestinian access to water so heavily restricted that basic consumption needs are barely met, or not met at all, there is no scope for the sustainable employment of this critical resource in combatting the effects of climate change.

The contamination of existing Palestinian water sources by Israeli settlements through the discharge of wastewater and dumping of solid waste therefore exacerbates an already severe challenge to Palestinian adaptive capacity. Such practices present direct threats to health while also harming Palestinian food production and local economies. In doing so, historic cultural connections to the land are weakened or broken entirely, with potentially profound social implications, including forced displacement.

6.3.3 Decreasing territory

Through Israel's annexation of land for settlement construction and other uses, the majority of Area C's total land mass (70 per cent) is effectively [off-limits for the use by and development of Palestinians](#), who in turn have only been allocated 1 per cent of land in Area C for development.

National strategic planning for combatting the effects of climate change typically requires large-scale infrastructure projects. Examples of such projects

which could be relevant to the West Bank context include water recycling and reuse systems; underground water storage; solar farms; drip irrigation systems; and environmentally-friendly transportation networks. As the Palestinian Area C 'land bank' is continuously depleted by settlement construction and expansion, the available space for physically housing such operations dwindles. In this way, settlements serve to directly and permanently undercut Palestinian resilience to climate change.

Furthermore, diversification of livelihood is a key climate adaptation strategy. For farmers, this may include diversified agricultural production, reducing reliance on a single income source or crop type. Crop rotation and fallow land^{xxiv} are examples of practices which allow for diversified production, but are increasingly unviable for the Palestinian agricultural sector as the amount of agricultural land is reduced and/or rendered otherwise unusable.

Also, in many global contexts, [migration has served as an adaptation strategy](#) for dealing with environmental changes. Reflecting this, in 2021, the UN Secretary-General's [High-Level Panel on Internal Displacement](#) recommended, "[w]here no alternatives exist to mitigate the risk of [climate-related] harm and displacement, States should facilitate migration out of areas at high risk or undertake planned relocation with the consent and participation of affected communities".^{xxv} In the context of Israel's occupation of Palestinian territory, and the longstanding reality of Palestinian forced displacement, any such initiative would entail significant logistical, political and legal complexity and include the risk of permanent displacement without guarantees of return.^{xxvi}

7 Conclusion

The environmental harm stemming from illegal Israeli settlements in the West Bank is multifaceted, encompassing deforestation, urbanisation, depletion of natural resources, air pollution from increased traffic and industrial output, and improper waste management.

As evidenced through the study of two locations—Wadi Shakhit and the Immanuel industrial zone—the repercussions of these practices can be far-reaching and felt most by neighbouring Palestinian communities.

Polluting of local water systems can create localised health concerns, while also contaminating agricultural lands, compromising crop viability and marketability. In turn, families and communities report serious economic hardship, and their long-standing connections to the land being stretched to breaking point. Ecosystems are disrupted, with native flora and fauna giving way to invasive species and the attendant threats to health and property.

This issue demands far greater attention, including detailed technical studies by Palestinian and international bodies to map the extent of the threats and impacts.

Meanwhile, Israel continues to expand its settlement project in direct contravention of international law. With the settler population in Area C and East Jerusalem projected to hit one million by 2035, the potential environmental impact is vast.

Global climate change further complicates this scenario. By the end of this century the average temperature in the West Bank is predicted to increase by as much as 4.4°C, placing impossible strain on the governance and resources of a territory and people now in the 57th year of a military occupation.

Israel's exclusive control of Area C precludes the PA from exercising meaningful power over the vast majority of the West Bank, from establishing a self-sustaining economy or from undertaking the large-scale development projects necessary to combat the effects of climate change.

As a result, settlement pollution and climate change-driven hazards are increasingly feeding into the existing coercive environment created by unlawful Israeli practices and policies in the West Bank. These include the widespread destruction of Palestinian homes and other property, mass land expropriation and settler violence,^{xxvii} which serve to forcibly displace West Bank Palestinians; a practice known as forcible transfer, which is a grave breach of international humanitarian law and prosecutable as a war crime.

Moreover, settlements (and their industrial zones) are themselves a product of—and an engine for—the occupation and its expansionist intent. A clear example of this can

be found in the reaction of settlers in 2020 to the proposed creation of a large Israeli IZ partly inside the West Bank; a move [heralded](#) by the head of a regional settlement council as a means of “[changing] the equation on the way toward seeing a million Jews in Judea and Samaria.”

It is therefore essential that any response to settlement pollution and its environmental impact must not only seek to cease such practices and mitigate existing harm, but also adopt a structural approach which correctly identifies and meaningfully addresses the root cause: Israel’s prolonged occupation and annexation of Palestinian territory.

8 Recommendations

1. In addressing the immediate environmental harm stemming from Israeli settlements, third states and international organisations:

- a) Must require Israeli authorities to immediately act to ensure that Palestinian communities, lands and resources are protected against the effects of disposal of waste originating from settlements, including the discharge of untreated or inadequately treated wastewater.
- b) Must require Israeli authorities, where harm has been caused to Palestinian communities, lands or resources as a result of disposal of settlement waste, to ensure that such practices are not repeated and that full reparations are made to affected persons.
- c) Must ensure sufficient funding and technical support is available for projects and initiatives to mitigate the impacts of settlement waste disposal on affected Palestinian communities, lands and resources.
- d) Must ensure sufficient funding and technical support is available for development projects and programmes to bolster Palestinian resilience to the effects of climate change, and ensure that this funding reaches affected communities.
- e) Must ensure that Palestinians, and particularly those affected by or at risk of displacement, play a leading role in climate change and water management planning.

2. In addressing the structural issues behind, and root causes of, environmental harm stemming from Israeli settlements, third states and international organisations:

- a) Must publicly acknowledge and condemn Israel's ongoing annexation of West Bank territory, including through settlement construction and expansion and the resulting forcible transfer of Palestinian residents.
- b) Must publicly call for, and actively pursue through all available means, the end of Israel's occupation of the West Bank, including East Jerusalem, and the Gaza Strip.
- c) Must require Israel to immediately comply with its obligations under international law, including ceasing and reversing its settlement construction and expansion in the West Bank, making guarantees of non-repetition, and providing full reparations.

- d) Must, in the event that settlement construction and expansion continues, map out concrete measures, beyond mere condemnation, which may be lawfully applied against Israel with a view to preventing such violations.
- e) Should proactively promote replacing of the existing discriminatory planning regime applied by Israel in Area C of the West Bank with a rights-based, Palestinian-led alternative.^{xxviii}
- f) Should highlight the linkage between environmental degradation and human rights violations—including the right to a safe, clean, healthy and sustainable environment—in all relevant communications.

Annex I: chemical and biological analysis

Biological and chemical analysis of Wadi Shakhit water samples

Parameter	Result
Faecal Coliforms	TMTC/100ml
Escherichia coli	TMTC/100ml
Listeria monocytogenes	Absent/100ml
Clostridium Perfringens	71 cfu/100ml
Lead (Pb)	Not detected
Cadmium (Cd)	Not detected
Chromium (Cr)	0.03 ppm
Mercury (Hg)	Not detected
Copper (Cu)	0.04 ppm
pH	6.95
Biochemical Oxygen Demand (BOD5)	198 mgO ₂ /l
Chemical Oxygen Demand (COD)	312 mgO ₂ /l
Total Suspended Solids (TSS)	960 mg/l
Total Dissolved Solids (TDS)	1735 mg/l
Electrical Conductivity (EC)	2.59 ms/cm
Magnesium (Mg)	101 mg/l
Nitrate-Nitrogen (NO ₃ -N)	5 mg/l
Calcium (Ca)	100 mg/l
Chromium (Cr)	0 mg/l
Carbon Monoxide (CO)	1.3 mg/l
Nickel (Ni)	0.115 mg/l

Biological analysis of Wadi Shakhit soil samples

Parameter	Result
Faecal Coliforms	TMTC/g
Escherichia coli	1950 cfu/g
Listeria monocytogenes	Absent/25g
Salmonella	Absent/25g
Clostridium Perfringens	890 cfu/g

Biological and chemical analysis of Immanuel water samples

Parameter	Result
Faecal Coliforms	TMTC/100ml
Escherichia coli	TMTC/100ml
Listeria monocytogenes	Absent/100ml
Clostridium Perfringens	71 cfu/100ml
Lead (Pb)	Not detected
Cadmium (Cd)	Not detected
Chromium (Cr)	0.02 ppm
Mercury (Hg)	Not detected
Copper (Cu)	0.02 ppm
Arsenic (As)	Not detected
pH	6.57
Biochemical Oxygen Demand (BOD5)	197 mgO ₂ /l
Chemical Oxygen Demand (COD)	557 mgO ₂ /l
Total Suspended Solids (TSS)	8809 mg/l
Total Dissolved Solids (TDS)	1715 mg/l
Electrical Conductivity (EC)	2.56 ms/cm
Magnesium (Mg)	217 mg/l
Nitrate-Nitrogen (NO ₃ -N)	39 mg/l
Calcium (Ca)	40 mg/l
Chromium (Cr)	0 mg/l
Carbon Monoxide (CO)	11.3 mg/l
Nickel (Ni)	0.115 mg/l

Biological analysis of Immanuel soil samples

Parameter	Result
Faecal Coliforms	TMTC/g
Escherichia coli	2250 cfu/g
Listeria monocytogenes	Absent/25g
Salmonella	Absent/25g
Clostridium Perfringens	910 cfu/g

Annex II: socioeconomic survey (translated)

Personal Information:

Name	
ID Number	
Mobile Number	
Gender	
Marital Status	
Number of Family Members	
Main Occupation	

	Average Income %	Average Income %
Monthly Income		
Average Income from the Main Source (Work or Job)		
Annual Income from Agriculture (Previous)		
Annual Income from Agriculture (Current)		
Other Sources of Income		
Total Income		

1. Total Land Area:
2. Land Ownership:
3. Is the land cultivated?
Yes No
4. If yes, how many dunams are cultivated?, what are the cultivated crops?
.....
5. Is the land irrigated?
Yes No
6. If yes, what is the source of irrigation?
.....
7. Is the land worked permanently?
Yes No
8. Is there a way to access the land?

Yes No

9. Does the land need reclamation or rehabilitation?

Yes No

What is the area of this land?

If the land is cultivated, answer the following accurately:

Production Input Costs	Previous Cost	Current Cost
Agricultural Operations (Plowing, Weeding, Pruning, Harvesting)		
Materials and Tools Required for Working on the Land		
Labour		
Transportation		
Land Reclamation Costs		

10. Have you faced marketing problems for agricultural products, both plant and animal products, after the wastewater flooding?

Yes No

The following table assess the negative impacts of settlements on the Palestinian environment. Please provide your opinion based on what you deem appropriate

No	Items	Level of impact				
		Very strong	Strong	Average	Little	Very little
1	Annoyance caused by these settlements.					
2	Emission of foul odors from wastewater coming from the settlements.					
3	Increased proliferation of flies and insects.					

4	Disposal of wastewater near grazing areas.					
5	Increase in diseases among cattle and sheep grazing near wastewater.					
6	Impact on agricultural areas due to this wastewater.					
7	Impact on the quality of nearby wells.					
8	Spread of diseases such as diarrhea and malaria among the population.					
9	Crop damage due to wastewater flooding.					
10	Material losses due to wastewater flooding.					
11	The impact on scenic overview of the area					

Was the productivity of cultivated crops on the land, in terms of quantity and quality, affected?

.....

If the answer is yes, what is the nature of this impact ?

.....

Did the quantity or quality of cattle and sheep products get affected?

If the answer is yes, what is the nature of this impact ?

.....

In your opinion, has there been an impact on neighboring lands in terms of the presence of insects and foul odors?

Yes No.

What is the nature of this impact..... ?

Did some landowners in your area abandon their land after the wastewater flooding?

Yes No

Are you aware of institutions that can provide assistance or support to affected landowners?

Yes No

Have you attended seminars or lectures on wastewater and its impact on agricultural land or other topics?

Yes No

Any additional comments:

.....

.....

Thank you for your cooperation.

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Endnotes

ⁱ Katz (January 2024). West Bank Jewish Population Stats. January 2024. P.3

ⁱⁱ Ibid. P.13

ⁱⁱⁱ This is in addition to the discharge of untreated or inadequately treated wastewater originating from Palestinian communities in the West Bank. According to the [World Bank](#), as of 2018, 25 million cubic meters (MCM) of untreated sewage were discharged into the environment annually, owing in large part to the dilapidated state of infrastructure stemming from severe restrictions imposed by Israel on Palestinian planning and construction.

^{iv} See Weizman (2007). Hollow Land: Israel's architecture of occupation. Chapter 3.

^v Who Profits, 2019. [Industrial Zones in the occupied Palestinian territory](#).

^{vi} Ibid.

^{vii} Applied Research Institute - Jerusalem, 2016. [Status of the Environment in the State of Palestine 2015](#). P.121.

^{viii} Ibid. P.122.

^{ix} An English translation of this questionnaire is provided in Annex II.

^x These settlements are as follows: Alon Shvut, El'azar, Efrata, Bat Ayin, Har Gilo, Kfar Etzion, Migdal Oz, Neve Daniel, Rosh Tzurim, Ma'aleh Amos, Nokdim, Tekoa, Metzad/Asfar, and Beitar Illit.

^{xi} Katz (January 2024). West Bank Jewish Population Stats.

^{xii} Affected community members report raising concerns directly with the settlements in question, but this has not helped prevent further discharges.

^{xiii} Results of the chemical and biological analysis of water and soil samples for both sites are provided in Annex I.

^{xiv} Council Directive of 21 May 1991 concerning urban waste water treatment. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01991L0271-20140101>. P.14.

^{xv} Ibid. P.14.

^{xvi} Ibid. P.15.

^{xvii} This increased use of chemical pesticides necessitated by increased weed growth may itself expose farmers and their lands to additional pollutants.

^{xviii} Though the Near Eastern wild boar is native to the Middle East, the breed commonly found in Israel and the West Bank is believed to have [originated in Europe](#) before being brought to the region some 3,000 years ago.

^{xix} The term ‘dual-use’ refers to goods, materials and equipment that have both potential civilian and military purposes.

^{xx} Israel disputes as a matter of law both its status as an occupying power and the applicability of IHRL to its actions in the West Bank. However, both of these stances have been rejected by the [International Court of Justice](#), as well as other authoritative bodies.

^{xxi} See, for example: UN Human Rights Council Resolution A/HRC/RES/48/13, adopted 8 October 2021; UN General Assembly Resolution A/RES/76/300 of 28 July 2011.

^{xxii} United Nations World Health Organization (2022). Occupied Palestinian territory: Health and Climate Change Profile 2022. P.6.

^{xxiii} Examples of such infrastructure include water conservation and management systems, desalination plants, and renewable energy installations.

^{xxiv} ‘Fallow land’ refers to land being temporarily left unplanted to allow for soil to recover and regain nutrients.

^{xxv} Recommendation 8. P.68.

^{xxvi} Climate change-related cross-border displacement is of growing significance in the context of international refugee law, with the UN Human Rights Committee [affirming in January 2020 that countries cannot deport individuals where climate change-induced conditions constitute a violation of the right to life](#).

^{xxvii} Settler violence can be attributed to Israel through *inter alia* its transfer of settlers into the West Bank, its failure to hold violent settlers to account, the common presence and participation of Israeli forces during settler attacks, the financing and arming of civilian guarding squads; and incitement to violence by Israeli government officials.

^{xxviii} Based on the work of Leilani Farha, former UN Special Rapporteur on the Right to Adequate Housing, NRC proposes establishing an [autonomous Area C building process stewarded by Palestinians for the benefit of Palestinians](#).