Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection

occupied Palestinian territory
COUNTRY REPORT

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The benefits in this report have been assessed, using available data, the source of which may not be entirely reliable, and with considerable data gaps requiring several assumptions. The results are therefore considered indicative only, providing an order of magnitude. However, the results are considered useful for making benefits of enhanced environmental protection understandable to a wide audience.

All data used in this report refer to 2008, unless otherwise indicated

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ACRONYMS

ARIJ .... Applied Research Institute – Jerusalem
CH4 .... Methane
CO_2 .... Carbon Dioxide
CO_2 eq .... Carbon Dioxide equivalent (in terms of Global Warming Potential)
DALYs .... Disability Adjusted Life Years
E. coli.................. Escherichia Coli
ENP .... European Neighbourhood Policy
ENPI .... European Neighbourhood and Partnership Instrument
EU .... European Union
EQA......................Environment Quality Authority
FAO .... Food and Agriculture Organisation
GDP..................... Gross Domestic Product
GES...................... Good Ecological Status
GHG.................. .. Greenhouse gas emissions
GLASOD.............. GLobal Assessment of human-induced SOil Degradation
GW...................... Groundwater
HH....................... Households
Ktoe.....................Kilo tons of oil equivalent
MCM .... Million cubic meters
MICS.................... Multiple Indicator Cluster Survey
MoEP.................. Ministry of Environmental Protection (Israeli)
MSA .... Mean Species Abundance
MSW................... Municipal Solid Waste
NIS .... New Israeli Sheqel
NMVOCs............. Non-Methane Volatile Organic Compounds
NOx .... Nitrogen Oxides
oPt .... occupied Palestinian territory
PCBS.................... Palestinian Central Bureau of Statistics
PWLS.................... Palestine Wildlife Sociaty
PM .... Particulate Matter
PPP...................... Purchasing Power Parity
PV........................Photovoltaic
RES....................... Renewable Energy Sources
SO_X .... Sulphur Oxides
SO2 .... Sulphur Dioxide
SSWWT .... Small Scale Wastewater Treatment Plants
SW....................... Surface Water
SWH..................... Solar Water Heaters
UNDG.................. United Nations Development Group
UNDP .... United Nations Development Programme
UNICEF................ United Nations Children's Fund
VOCs .... Volatile Organic Compounds
WEI .... Water Exploitation Index
WHO .... World Health Organisation
WTP .... Willingness to Pay

EXECUTIVE SUMMARY: ENGLISH / ARABIC

Introduction

The European Union, represented by the European Commission has contracted a consortium led by ARCADIS Belgium N.V. to undertake an analysis of social and economic benefits of enhanced environmental protection in the 16 countries covered by the European Neighbourhood Policy (ENP) and in the Russian Federation.1 The other consortium partners are: Institute for European Environmental Policy (IEEP), Ecologic Institute, Environmental Resources Management Ltd. and Metroeconomica Ltd.

This is the executive summary of the report on the benefit assessment for the occupied Palestinian territory (OPT) that has been prepared by team consisting of an EU expert and a national expert, using a Benefit Assessment Manual developed under the project. This Benefit Assessment Manual which was originally for internal use only, has been turned into a Benefit Assessment Manual for Policy Makers[2] for wider dissemination. The Manual provides an understanding of the methodologies applied for the benefit assessment and is available from the project's website www.environment-benefits.eu.

The situation in the OPT is unique in the sense that the Palestinian National Authority (PNA) has only limited control over its own territory and nature resources. Consequently, the Israeli occupation and its consequences both dominate other internal policies, including environmental policies, and also limit the scope for action by the Palestinian National Authority (PNA). In line with the Oslo agreement, the PNA only has authority to decide freely on the 2.7% of the West Bank that fall under the "Area A" and – within limits – the 25.1% under "Area B". For the majority of the territory (72.2%) that belongs to the "Area C", the PNA has no control. This has very practical implications for decisions like designating and accessing nature reserves and protected areas, establishing landfills, drilling wells or constructing sewage treatment plants. Often, such projects can only be undertaken in the "Area C", as areas A and B are typically densely populated, built-up areas. However, any projects in Area C require the consent and cooperation of Israeli Authorities.

There are considerable benefits from taking immediate action to address the environmental problems facing the OPT and enhancing sustainable development. These include improvements to health and reductions in mortality, economic savings and the potential for new economic opportunities, and widespread gains in

1 EuropeAid DCI-ENV/2009/225-962 (EC)

2 Bassi, S (IEEP), ten Brink, P (IEEP), Farmer, A (IEEP), Tucker, G (IEEP), Gardner, S (IEEP), Mazza, L (IEEP), Van Breusegem, W (EMS Consulting), Hunt, A (Metroeconomica), Lago, M (Ecologic), Spurgeon, J (ERM), Van Acoleyen, M (Arcadis), Larsen, B, Doumani, F. 2011. *Benefit Assessment Manual for Policy Makers: Assessment of Social and Economic Benefits of Enhanced Environmental Protection in the ENPI countries.* A guiding document for the project 'Social and Economic Benefit Assessment for countries covered by the European Neighbourhood Policy Instrument (ENPI-SEBA)'.

community well-being. This report provides a first look at the potential social and economic value stemming from these improvements across environmental sectors. The numbers cited in this report are indicative only, based on a rapid assessment often using limited data and many assumptions. Looking ahead, more detailed assessments will also help to support policy-making and economically sound decision-making on environmental issues in the future.

Air

In the OPT there are few data on air pollutant emissions since there is hardly any adequate measurement infrastructure, and assessments of air quality rely on estimated emissions, rather than measured air quality levels. All in all, the knowledge base and data availability is very poor for air quality, and does not allow a very detailed analysis.

Nevertheless, there is evidence that the OPT suffers from substantial air pollution, especially in the urban areas and their surroundings. As there are only few large point sources of air pollution (especially stone quarries – other typical polluters, such as power plants or heavy industry, do not operate in the West Bank or Gaza). The main source of air-borne emissions in the OPT is therefore the transport sector, especially due to the increasing intensity of traffic in urban areas (for example in Gaza) and the aged fleet of cars and trucks. Other sources of air pollution include the unmanaged burning of household and agricultural waste. Overall, the weakness of the executive authority, coupled by the effects of the Israeli occupation, leads to a rather weak enforcement of regulation and legislation concerning air quality.

In addition to domestic sources, air pollution in the OPT is caused by trans-boundary pollution from green-line Israel, as well as air pollution from Israeli industries, which relocate to the West Bank to escape the stricter environmental regulation in Israel. Also here the problem of data availability prevails, as data on air pollution from Israeli settlements or from green-line Israel are virtually absent, with only anecdotal (and often contested) evidence.

Based on the available data, the benefits of reduced air pollution can be quantified for ammonia (NH_3), particulate matter (coarse and fine) (PM), nitrogen oxides (NOx), sulphur dioxide (SO_2) and non-methane volatile organic compounds (NMVOCs). If ambient pollution levels for these pollutants were reduced by 50% by 2020, modelling results suggest that the number of premature deaths could be reduced by 220 each year. Morbidity impacts would amount to 440 cases of chronic bronchitis avoided. Other benefits would include building materials, i.e., the premature ageing of building materials as a consequence of exposure to SO_2 deposition, with benefits in the form of avoided clean-up and replacement costs. Furthermore, agriculture benefits in terms of avoided crop yield losses that result from the change in pollutant concentrations in the air.

For a 50% emission reduction scenario by 2020, the annual monetary benefits of reduced air pollution amount to EUR (PPP) 68 million each year, equivalent to 0.5% of annual GDP. These are merely domestic benefits; transboundary effects could not be considered in this analysis. The benefits consist of avoided morbidity and mortality, avoided damage to buildings and avoided crop yield losses, with the avoided health impacts accounting for more than 90% of all benefits.

Water

Water is the most prevalent issue on the Palestinian environmental agenda, and access to water is also among the most contentious points in the negotiations between Israel and the Palestinian Authority as Israel controls all of Palestinian surface and ground water. The Israeli occupation strongly influences the OPT water situation, both in terms of access to the available water resources, and by limiting the Palestinian National Authority's capacities to effectively improve the situation (e.g., drilling water wells, construction of wastewater treatment infrastructure).

Gaza and the West Bank rely on groundwater for more than 95% of their water needs, as access to the only permanent river, the Jordan River, is denied to the Palestinians while precipitation is limited (500 – 600 mm per year on average) and concentrated in the months from December to March. In the Gaza Strip, scarcity and overuse has reached critical levels which has resulted in the intrusion of sea water into the Coastal Aquifers and a consequent deterioration in water quality.

In terms of improved access to drinking water, sanitation and hygiene, water services have deteriorated, particularly in rural areas, due to inadequate maintenance of municipal water systems. While nearly 80% of the population in the West Bank and Gaza have piped water supply on their premises (WHO, UNICEF, 2010a,b), around 170 villages in the West Bank still lack access to a piped water system (ARIJ, 2006b). The available water supply is therefore not adequate to properly address public health concerns.

Through improved access to water services, an additional 1.2 million people (0.2 million households) would benefit from reliable and safe piped water to premises, and an additional 1.9 million people (0.3 million households) would be connected to a sewage network system. The annual benefits of achieving the targets in 2020 amount to 1.2 - 2.6 million avoided cases of diarrhoea and 88 - 193 avoided deaths. This corresponds to monetized benefits of € PPP 45 – 99 million or NIS 118 – 260 million, equivalent to about 0.3 - 0.7% of 2020 GDP.

In terms of wastewater collection, the majority of households in urban areas is already connected to wastewater collection, with connection rates of up to 90%. However, connection is significantly less in rural areas; in addition, some major cities (e.g., Jericho) remain without centralised wastewater collection. Regarding wastewater treatment, the currently existing treatment plants in the OPT are clearly inadequate to handle the amount of wastewater collected. Thus, in the West Bank, 93% (33.5 MCM/year) of produced wastewater is discharged untreated into the environment. The wastewater treatment plants located in the Gaza Strip, which only function at moderate efficiency rates (40-60%), operate above their capacity and are in need of upgrade and maintenance. 4.9 MCM/year of untreated wastewater and the (partially) treated wastewater is discharged into the environment (ARIJ, 2007, p.

122). The lack of effective wastewater treatment has impacts on nature, biodiversity and groundwater quality and endangers public health (ARIJ, 2007). Assuming a standard that would correspond to the 1991 EU Urban Waste Water Treatment Directive (CEC, 1991), an additional 5.25 million inhabitants would need to be connected to at least secondary treatment plants, which would result in additional 87.9 MCM of wastewater being treated at least at secondary level.

As regards water resource scarcity, both the mountain aquifer underlying the West Bank and the Coastal Aquifer underlying Gaza are exploited above the rate of natural recharge. But Palestinian abstractions only account for some 20% of the “estimated potential”. The substantial overdraft is thus mainly caused by Israeli abstractions, which exceed the internationally agreed allocation by 80% (World Bank, 2009). While it is true that the region experiences severe water stress and unsustainable use of water, this problem is largely due to the uneven distribution of water between the OPT, Israeli settlements and green-line Israel.

The pressures on water availability include population growth, growth in agricultural and industrial production, as well as general economic development. These pressures continue to put a strain on the limited water resources available, both in terms of water quality and quantity. In recent years, the existing scarcity problem has been further exacerbated by repeated drought cycles, so that natural water resources were overused beyond their natural recharge (ARIJ, 2007).

Decreasing groundwater abstractions from the coastal aquifer would reduce the further spread of brackish water in the coastal aquifer (saline intrusion), benefiting humans and the environment alike. The potential economic consequences of droughts (in the form of reduced crop output) can be substantial, which suggests a change to more drought-resistent crops. At the same time, increased water security can motivate farmers to plant higher value multi-year crops, such as grapes, for which water security needs to be guaranteed. This also allows growing crops with higher agricultural capital accumulation (i.e. trees and other plants which take a significant time to mature), which are more profitable than single season crops (Lavee, 2010).

Waste

Municipal Solid Waste (MSW) is a significant contributor to environmental and health-related problems in the OPT. Waste management in the OPT is still in its infancy. Most of the waste in the OPT (about 69%) is dumped in random dumpsites, which by usually started off as a makeshift dump areas by some local residents and expanded thereafter. Hence, neither the location nor the set up of these dumpsites are subject to minimal health or environmental standards. It is estimated that some 450 illegal dumpsites exist in the OPT. Waste management in the OPT is hindered by a variety of factors, including the lack of infrastructure for waste collection and waste treatment (with only a few landfills built to international standards and virtually no recycling); lack of public awareness on waste disposal and associated health risks; weak and underfunded governmental institutions; and land-segregation coupled with the continual interruption of public civil services due to the Israeli occupation. This results in a variety of environmental problems, such as pollution of soils and groundwater or the release of harmful gases, as well as the spread of diseases, unpleasant odours, and so on.

Over the last decade, several efforts have been made to improve MSW management, such as the construction of several landfills in the Gaza strip and in the West Bank, largely due to donors' support. In addition, the Palestinian Authority has issued a national strategy for Solid Waste management for 2010-2014. The implementation of this plan, however, largely depends on the ability to increase significantly the institutional capacity to reinforce legislation and mobilize funds (internally and externally).

There are many environmental, social, economic and health benefits of improved waste management, including reduced air pollution from dumpsites, particularly when these dumpsites catch fire or are burnt intentionally, and toxic and carcinogenic gases are released. Other benefits include reduced leachate from unmanaged dumpsites, and the associated soil and groundwater contamination. Finally, proper waste management reduces population exposure to insect- and animal-borne (e.g., rodents) diseases. Economic benefits of proper waste management include the reduced costs of health care from improved air and water quality and avoided diseases, but also the revenues from recycled materials and composted organic waste that can be used as secondary raw materials.

Another benefit consists in reduced methane emissions. Biodegradable waste can generate large amounts of methane, a greenhouse gas with a much higher global warming potential than CO2. There are several available technologies to capture methane from biodegradable waste (biomass) in order to flare it, or to produce energy from burning methane. This can reduce emissions which otherwise would have been emitted to the atmosphere, and help to reduce dependency on fossil fuels for energy production. This study estimated that as much as 145,9 million m^3 of methane could be avoided or captured. Since methane has a global warming potential much stronger than CO2 (by a factor of 21), these methane emissions are equivalent to 2.08 million tons of CO2 eq. Avoiding these emissions corresponds to a monetary benefit of EUR 41.7 - 116.6 million.

Nature and biodiversity

The OPT is located in a unique position between different bio-geographic regions: the European, Asian and African continents, the Mediterranean and the Red Sea. As a result of this distinctive situation, the region boasts a remarkable high biodiversity within a relatively small area. However, while these ecosystems support a range of human activities and create benefits in different ways (including agriculture, animal husbandry, forestry, traditional and pharmaceutical health products, and many others), these benefits largely escape an economic assessment and a valuation in monetary terms.

A number of pressures continue to affect natural habitats in Palestine: unplanned urban expansion, overgrazing, over-exploitation, deforestation and unplanned forestry activities, desertification and drought, soil erosion, hunting, invasive alien species, pollution, and contamination. An efficient response to these threats is complicated by the conditions of the Israeli occupation (including the lack of control over the country's territory and natural resources, settlements, bypass roads, closed military areas, separation wall, etc), which limits the Palestinian Authority's ability to regulate land use, to properly monitor the status of the environment and to enforce environmental protection measures.

The benefits that can be approximately quantified include the on-farm value of limiting cropland degradation, which is manifest in increased crop yields from improved land management. These benefits are estimated at € PPP 41-68 million (annual benefits as of 2020, if the environmental target is met). This is equivalent to 0.29-0.48% of projected 2020 GDP.

Likewise, the benefits of halting (and eventually reversing) deforestation can be approximated through the value of forests as a carbon sink. The OPT has been experiencing deforestation at a rate of 0.8% per year. If this could be reduced to zero by 2020 (i.e. no further deforestation after 2020), the annual benefit would amount to 14.6 – 40.6 million Euro only in terms of the CO2 sequestered in the forests. This is only a rough assessment, and an underestimation of the total economic value of the forests, as it fails to cover important use and non-use benefits, e.g. timber and non-timber forest products, recreational uses, and ecosystem services like water and air purification, protection of soil against erosion, etc.

Climate Change

Palestine is, like the rest of the world, facing challenges derived from climate change. With the existing problems related to water scarcity in both the West Bank and Gaza, water resources appear to be most susceptible to climate change, with further deterioration as a consequence. This will strongly affect both the agriculture and health sectors, thus reducing economic, water and food security. Agricultural livelihoods, particularly within rural rain-fed farming communities, are always directly affected by rainfall and drought incidence, as well as increase in extreme weather events (storm, heat waves, etc.). While a detailed assessment of the possible impact of climate change is lacking, some changes in the precipitation pattern could be observed in the last decade and were attributed by the Palestinian authorities to climate change. Climate change is expected to further exacerbate water scarcity issues in the OPT. In addition, the lack of water may result in an increase of health issues such as diarrhoea, cholera, and dehydration. The risk of parasitic disease may also increase with climate change.

There is a growing awareness of the potential impacts of climate change, documented in the Climate Change Adaptation Strategy and Program of Action for the Palestinian Authority, which was jointly prepared by the EQA and UNDP in a participatory approach that involved all relevant stakeholders. Furthermore, there is still a limited amount of quantifiable and modelled knowledge on climate change impacts in the OPT, and the resulting social and economic consequences, which could support the formulation of such a strategic policy in the future.

Since Palestinian per-capita emissions are relatively low by international standards, mitigation of greenhouse gas emissions is not very high on the policy agenda. Still, in recent years the Palestinian Authority has expressed increased interest in the development of Renewable Energy Sources (RES). This is arguably due to the considerable co-benefits of deploying renewable energy sources: other than reducing greenhouse gas emissions, they also help to reduce dependency on imported fuels and electricity, they can be used to support the electrification of rural and remote households, and they can contain the cost of energy services. Currently, 80% of the energy consumed in the OPT is based on fossil fuels, in the form of electricity and petroleum products, which are almost entirely imported from Israel. This creates a serious constraint for the OPT in developing its own energy policy, and a strong incentive to develop indigenous energy sources. RES already accounts for nearly 18% of final energy consumption in the OPT, mainly through Solar Water heaters installed on some 60% of the households. In addition, several sporadic initiatives were undertaken for the deployment of photovoltaic cells or wind turbines in rural areas. However, there is still great potential in the OPT for the deployment of 'low-hanging-fruits', such as further deployment of solar heaters or the utilization of organic waste for biogas production. Similarly to other policy fields, the deployment of RES is hindered by lack of coordinated policy and capacity to mobilize the funds required for the initial investments.

This study has looked at two policy scenarios that would expand the share of RES from its current 18% to 25% by 2020 in the less ambitious scenario, and to 30% in 2020 in the ambitious case. The policies adopted in these scenarios will reduce CO2 emissions by 344,996 – 589,930 tons per year, compared to business as usual. Expressed in monetary units, based on three estimates of the price of carbon in the global market, this corresponds to annual benefits of EUR 7-19 million for the 25% RES target. The annual monetary benefits for a 30% RES target range between EUR 11.8-33 million.

Summary of the key benefits

The following table provides a summary of the key benefits assessed in the project across the different thematic areas.

Summary of annual key benefits across thematic areas			
	Qualitative	**Quantitative**	**Monetary**
Air	Reduced impact of air pollution on ecosystems and vegetation, avoided impacts on buildings and materials, improved quality of life esp. in urban area (outdoor activities and recreation)	Avoided health impacts of air pollution (reduced incidence of respiratory diseases): 220 cases of avoided premature death, 440 cases of avoided morbidity	Annual monetised health benefits (reduced mortality and morbidity): € PPP 68 million
Water	Lack of effective wastewater collection and treatment has impacts on nature, biodiversity and groundwater quality and endangers public health	1.2 million people with reliable and safe piped water to premises, and an additional 1.9 million people connected to a sewage network system. 1.2 - 2.6 million avoided cases of diarrhoea and 88 - 193 avoided deaths 5.25 million inhabitants connected to at least secondary treatment plants, additional 87.9 MCM of wastewater treated at secondary level	Avoided health impacts and avoided mortality: annual monetised health benefit of € PPP 45 – 99 million
Waste	Increasing the recycling of waste increases the availability of secondary raw materials; organic waste can be used for generating energy Reduced air and water pollution and health impacts from proper sanitary landfills, preventing uncontrolled burning of household waste	Deviating biodegradable waste away from landfills and capturing methane from landfills: 146 million m^3 of avoided methane emissions, equivalent to 2.08 m tons of CO_2	Avoided emission of 2.08 million tons CO_2-eq corresponds to a benefit of EUR 41.7 - 116.6 million
Nature	Numerous benefits in terms of amenity and recreation, purification of air and water, avoided erosion.	Halting current deforestation trends by 2020 – avoiding 726,000 of CO_2 released from existing	Limiting the extent of crop yield losses from cropland degradation: Euro 41-68 million per year

Summary of annual key benefits across thematic areas			
	Support of local biodiversity and related products, e.g., medicinal herbs Timber and non-timber products from forests	forest stock	Benefit of halting deforestation: 14.6 – 40.6 million Euro of sequestered CO_2 alone
Climate	Reduced dependence on fossil fuel imports	Increase share of renewables to 25% or to 30%, corresponding to reduced fossil fuel consumption of 128 – 216 tons of oil equivalent (below reference)	Annual monetary benefits of reduced CO_2 emissions: EUR 7-19 million for the 25% RES target; EUR 11.8-33 million for the 30% target

الأراضي الفلسطينية المحتلة

بصفتها ممثلاً عن الاتحاد الأوروبي، تعاقدت المفوضية الاوروبية مع إتحاد شركات (كونسورتيوم) تقوده شركة اركاديس (ARCADIS Belgium N.V.) البلجيكية لإجراء تحليل للفوائد الاجتماعية والاقتصادية التي تعزز حماية البيئة في ست عشرة دولة تشملها سياسة دول الجوار الأوروبية (ENP) والاتحاد الروسي[3]. اما الشركاء الآخرون للكونسورتيوم فهم: معهد السياسات البيئية الأوروبية (IEEP)، المعهد البيئـي (Ecologic Institute) إدارة الموارد البيئة (ERM) وميتروايكونوميكا (Metroeconomica) وعدة خبراء مستقلين.
هذا هو الملخص التنفيذي للتقرير حول تقييم الفوائد في **الأراضي الفلسطينية المحتلة،** قام بإعداده فريق خبراء يتكون من خبير الاتحاد الأوروبي وخبير وطني، وذلك باستخدام دليل تقييم الفوائد الذي تم وضعه في إطار المشروع.[2] وقد تحول هذا الدليل، الذي كان أصلا معداً للاستخدام الداخلي فقط، الى دليل تقييم الفوائد لواضعي السياسات بغرض نشره على نطاق أوسع، والذي من شأنه المساعدة على فهم المنهجيات المطبقة في مجال تقييم الفوائد.
الوضع في الأراضي الفلسطينية المحتلة فريد من نوعه، بمعنى أن لدى السلطة الوطنية الفلسطينية قدرة محدودة لمراقبة أراضيها والتحكم بمواردها الطبيعية. وبالتالي فان الاحتلال الإسرائيلي وتداعياته على سياسات داخلية اخرى، بما فيها السياسات البيئية، يحد أيضا من نطاق الإجراءات التي تتخذها السلطة الوطنية الفلسطينية. ووفقاً لإتفاق أوسلو، للسلطة الوطنية الفلسطينية الحق ببسط سلطتها على 2,7 ٪ فقط من اراضي الضفة الغربية التي تقع تحت ما يسمى "المنطقة أ" - وبشكل محدود- تبسط سلطتها على 25,1 ٪ على "المنطقة ب". وبالنسبة لغالبية الأراضي (72,2 ٪) التي تنتمي إلى "المنطقة ج" ، ليس للسلطة الفلسطينية اي نفوذ لها ولا يمكنها بسط سيطرتها عليها. ويترتب على هذا الوضع آثار عملية بالنسبة للقرارات التي يتعين اتخاذها مثل تعيين المحميات الطبيعية والمناطق المحمية وحرية الدخول اليها، وإنشاء مطامر النفايات، وحفر الآبار أو بناء محطات معالجة مياه الصرف الصحي. في كثير من الأحيان ، لا يمكن القيام بمثل هذه المشاريع إلا في المنطقة "ج" ، حيث ان المناطق(أ) و (ب) هي عادة مناطق مبنية ومكتظة بالسكان. ومع ذلك، فإن أي مشاريع في المنطقة (ج) تتطلب موافقة وتعاون السلطات الاسرائيلية.

ثمة فوائد كبيرة للإجراءات الفورية المتخذة لمعالجة المشاكل البيئية التي تواجه السلطة الفلسطينية. وتشمل هذه التحسينات الصحة وخفض معدل الوفيات، وتحقيق الوفر الاقتصادي، وإمكانات توفر فرص اقتصادية جديدة، وتحقيق مكاسب واسعة على صعيد رفاهية المجتمع. يقدم هذا التقرير نظرة أولية للقيمة الاجتماعية والاقتصادية المحتملة الناجمة عن هذه التحسينات في مختلف القطاعات البيئية. إن الأرقام المذكورة في هذا التقرير هي فقط للدلالة، وتستند إلى تقييم سريع غالباً ما تستخدم فيه بيانات محدودة وافتراضات كثيرة. وبانتظار إجراء تقييمات تفصيلية يمكن الاضطلاع بها في المستقبل، من المتوقع أن يوفر هذا التقرير المساعدة المرجوة لدعم رسم السياسات وصنع القرارات السليمة بشأن القضايا البيئية.

الهواء

في الأراضي الفلسطينية المحتلة، البيانات قليلة عن انبعاثات المواد الملوثة في الهواء في ظل غياب البنية التحتية الكافية لقياس جودة الهواء، والذي يتم تقييمه استناداً الى تقديرات الانبعاثات، وليس بقياس مستويات جودة الهواء. إجمالاً، إن قاعدة المعارف وتوافر البيانات المتعلقة بنوعية الهواء، ضعيفة جدا ولا تسمح باي تحليل مفصل.

ومع ذلك، فاالدلالات واضحة على أن الأراضي الفلسطينية المحتلة تعاني من تلوث كبيرفي الهواء، لا سيما في المناطق الحضرية والمناطق المحيطة بها. ولما لم يكن هناك سوى القليل من المصادر الكبيرة لتلوث الهواء (خصوصا الكسارات – اما المصادر الاخرى الملوثة للبيئة، مثل محطات توليد الطاقة او الصناعات الثقيلة، فهي غير موجودة في الضفة الغربية أو في قطاع غزة). لذا، فإن المصدر الرئيسي للانبعاثات الملوثة للجو في الأراضي الفلسطينية المحتلة هي قطاع النقل، وخاصة بسبب زيادة كثافة حركة المرور في المناطق الحضرية (في غزة مثلاً) والاسطول القديم من السيارات والشاحنات. هناك مصادر أخرى لتلوث الهواء وتشمل حرق النفايات المنزلية والزراعية العشوائي. عموماً، إن ضعف

[1] EuropeAid DCI-ENV/2009/225-962 (EC)
[2] Bassi, S (IEEP), ten Brink, P (IEEP), Farmer, A (IEEP), Tucker, G (IEEP), Gardner, S (IEEP), Mazza, L (IEEP), Van Breusegem, W (EMS Consulting), Hunt, A (Metroeconomica), Lago, M (Ecologic), Spurgeon, J (ERM), Van Acoleyen, M (Arcadis), Larsen, B, Doumani, F. 2011. *Benefit Assessment Manual for Policy Makers: Assessment of Social and Economic Benefits of Enhanced Environmental Protection in the ENPI countries.* A guiding document for the project 'Social and Economic Benefit Assessment for countries covered by the European Neighbourhood Policy Instrument (ENPI-SEBA)'

السلطة التنفيذية مقرونة بآثار الاحتلال الاسرائيلي ، يؤديا إلى ضعف في تطبيق الأنظمة والتشريعات المتعلقة بجودة الهواء.

الى جانب التلوث من مصادر محلية، هناك مصادر اخرى تتسبب بتلوث الهواء في الأراضي الفلسطينية المحتلة والمتأتية من خلف الخط الاخضر/الحدود مع اسرائيل، فضلا عن تلوث الهواء من الصناعات الإسرائيلية، والتي اخذت تنتقل إلى الضفة الغربية هرباً من صرامة الأنظمة البيئية في إسرائيل. هنا أيضا تسود مشكلة توافر البيانات، ذلك ان البيانات عن تلوث الهواء من المستوطنات الإسرائيلية أو من الخط الأخضر في إسرائيل هي تقريباً مفقودة، او تكون مصحوبة بأدلة مضحكة فقط (غالباً ما يطعن في صحتها).

استنادا إلى البيانات المتاحة، يمكن تحديد فوائد تخفيض تلوث الهواء كماً بالنسبة للأمونيا (NH_3) ، والجسيمات PM (الخشنة والناعمة)، وأكسيد النيتروجين (NOx)، وثاني أكسيد الكبريت (SO_2)، والمركبات العضوية المتطايرة غير غاز الميثان (NMVOCs). وإذا ما تم تخفيض مستويات تلوث البيئة المحيطة لهذه الملوثات بنسبة 50 ٪ بحلول عام 2020، تشير نتائج النمذجة أنه يمكن تخفيض عدد الوفيات المبكرة 220 حالة في كل عام، وتجنّب 440 حالة من حالات التهاب القصبات. وتشمل الفوائد الأخرى مواد البناء، مثل التقادم المبكر لمواد البناء بسبب تعرضها لترسبات SO_2، مع فوائد على شكل تجنب تكاليف التنظيف والاستبدال. وعلاوة على ذلك، هناك فوائد الزراعة من حيث تجنب خسائر المحصول والتي تنتج عن تغيّر في تركيزات الملوثات في الهواء.

لسيناريو خفض الانبعاثات بنسبة 50 ٪ بحلول عام 2020، تبلغ الفوائد النقدية السنوية لخفض تلوث الهواء 68 مليون € PPP (بسعر الصرف المعدل بالقوة الشرائية)، أي ما يعادل 0,5 ٪ من الناتج المحلي الإجمالي السنوي. هذه هي فقط الفوائد المحلية؛ ولا يمكن الاخذ بالاعتبار الآثار العابرة للحدود في هذا التحليل. وتتألف الفوائد من تلك التي تجنب الإمراض والوفيات، بالاضافة الى تجنب الأضرار التي تلحق بالمباني وبخسائر المحصول السنوي، حيث تبلغ نسبة تجنب الآثار الصحية 90 ٪ لجميع الفوائد.

المـياه

المياه هي من القضايا الاكثر إلحاحاً على جدول أعمال البيئة الفلسطينية، والحصول على المياه هو أيضاً من بين النقاط الأكثر إثارة للجدل في المفاوضات بين إسرائيل والسلطة الفلسطينية، إذ ان إسرائيل تسيطر على كل من المياه السطحية والمياه الجوفية الفلسطينية. يؤثر الاحتلال الإسرائيلي بشدة على حالة المياه في الأراضي الفلسطينية المحتلة، سواء من حيث الحصول على الموارد المائية المتاحة، او لناحية الحد من قدرات السلطة الوطنية الفلسطينية على تحسين الوضع على نحو فعّال (مثل حفر آبار المياه، وبناء البنية التحتية لمعالجة مياه الصرف).

تعتمد غزة والضفة الغربية على المياه الجوفية بنسبة تزيد على 95 ٪ لتغطية احتياجاتها للمياه، ذلك ان الوصول إلى نهر الاردن، النهر الوحيد الدائم، ممنوع على الفلسطينيين، في حين يقتصر هطول الأمطار (500 -- 600 مم سنويا في المتوسط) على الفترة الممتدة بين ديسمبر إلى مارس. وفي قطاع غزة، وصلت ندرة المياه والإفراط باستعمالها الى مستويات حرجة أدى إلى تداخل مياه البحر في الخزانات الجوفية الساحلية وقد ترتب على ذلك تدهور في نوعية المياه.

من ناحية تحسين فرص الحصول على مياه الشرب والصرف الصحي والنظافة، هناك تدهور في خدمات المياه، خاصة في المناطق الريفية، وذلك بسبب عدم كفاية الصيانة لشبكات المياه البلدية. في حين أن ما يقرب من 80 ٪ من السكان في الضفة الغربية وقطاع غزة ينعمون بالمياه المتوفرة عبر الأنابيب في منشآتهم (WHO/UNICEF، 2010 أ، ب) ، حوالي 170 قرية في الضفة الغربية لا تزال تفتقر إلى الوصول إلى نظام نقل المياه بواسطة الأنابيب (ARIJ، b2006) . لذلك، فإن إمدادات المياه المتاحة ليست كافية لمعالجة مشاكل الصحة العامة بشكل صحيح.

من خلال تحسين فرص الحصول على خدمات المياه، سيستفيد من المياه الجارية والآمنة والموثوقة في المنازل، 1,2 مليون شخص إضافي (اي 0,2 مليون أسرة) ، كما ان الاتصال بنظام شبكة الصرف الصحي سيستفيد منه 1,9 مليون نسمة إضافي (اي 0,3 مليون أسرة). إن الفوائد السنوية لتحقيق الأهداف في عام 2020 تجنّب ما بين 1,2 و 2,6 مليون حالة اسهال، وما بين 88 و 193 حالة وفاة. هذا يتوافق مع الفوائد النقدية بقيمة 45 و 99 مليون € PP ، أي ما يعادل حوالي ما بين 0,3 و 0,7 ٪ من الناتج المحلي الإجمالي في عام 2020.
وبالنسبة لتجميع مياه الصرف الصحي، لقد تم توصيل معظم المنازل في المناطق الحضرية بشبكة تجميع مياه الصرف الصحي، مع معدلات تصل إلى 90 ٪. ومع ذلك، فان التوصيل هو أقل بكثير في المناطق الريفية؛ إضافة إلى أن بعض

المدن الكبرى (مثل أريحا) لا تزال تفتقر الى تجميع مركزي لمياه الصرف الصحي. وبالنسبة لمعالجة مياه الصرف الصحي، ان محطات المعالجة القائمة حاليا في الأراضي الفلسطينية المحتلة غير كافية بشكل واضح لمعالجة المياه االمبتذلة التي تم جمعها. وهكذا، فان 93 ٪ (33,5 مليون متر مكعب / سنة) من مياه الصرف الصحي في الضفة الغربية يتم تفريغها في البيئة من دون معالجة. أما محطات معالجة مياه الصرف الصحي الموجودة في قطاع غزة، والتي تعمل بكفاءة معتدلة (40-60 ٪)، هي فعلاً تعمل فوق طاقتها وبحاجة للتطوير والصيانة. هناك، يتم تفريغ 4,9 مليون متر مكعب/ سنوياً من مياه الصرف الصحي غير المعالجة وتلك المعالجة جزئياً في البيئة (ARIJ، 2007 ، ص 122). إن الافتقار الى معالجة فعّالة لمياه الصرف الصحي له آثار على الاوساط الطبيعة، والتنوع البيولوجي، وجودة المياه الجوفية، ويشكل تهديداً على الصحة العامة (ARIJ، 2007). وإذا اخذنا كمعيار قياسي '' توجيهات الاتحاد الاوروبي لمعالجة مياه الصرف الصحي الحضري" - عام 1991 (CEC، 1991)، فإن 5,25 مليون نسمة سوف يحتاجون لان يتم شبكهم على الأقل بمحطات المعالجة الثانوية ، والتي من شأنها أن تؤدي إلى معالجة 87,9 مليون متر مكعب إضافية من مياه الصرف الصحي على الأقل على المستوى الثانوي.

بالنسبة لندرة الموارد المائية، فإن كلا من المياه الجوفية الكامنة وراء جبال الضفة الغربية ومياه الحوض الساحلي في غزة تستغل بمستوى أعلى من معدل التغذية الطبيعية. لكن التجريد الفلسطيني يقارب 20 ٪ من "المحتمل المقدر". وبذلك يكون السحب بكميات كبيرة ناجم أساساً عن التجريدات الإسرائيلية، بحيث يتم تجاوز الحصة المتفق عليها دوليا بنسبة 80 ٪ (البنك الدولي، 2009). في حين ان المنطقة تشهد فعلاً ضغطا حاداً على المياه واستخدام غير مستدام للمياه، تكمن المشكلة الحالية بالتوزيع غير العادل للمياه بين الأراضي الفلسطينية المحتلة، والمستوطنات الإسرائيلية وإسرائيل-الخط الاخضر.

إن الضغوط على وفرة المياه تشمل النمو السكاني، النمو في الإنتاج الزراعي والصناعي، فضلا عن التنمية الاقتصادية العامة. هذه الضغوط لا تزال تفرض عبئا على الموارد المائية المحدودة المتاحة، سواء من حيث نوعية وكمية المياه. في السنوات الأخيرة، زادت دورات الجفاف المتكررة من تفاقم مشكلة الندرة القائمة، بحيث تم استغلال موارد المياه الطبيعية بشكل مفرط فاق مستوى التغذية الطبيعية للمياه (ARIJ، 2007).
إن تقليص تجريدات المياه الجوفية من طبقة المياه الجوفية الساحلية سوف يحد من انتشار المزيد من المياه قليلة الملوحة داخل المياه الجوفية للمناطق الساحلية (تسرب المياه المالحة)، فيستفيد منها البشر والبيئة على حد سواء. ان العواقب الاقتصادية المحتملة لحالات الجفاف (على شكل خفض في انتاج المحاصيل) يمكن أن تكون كبيرة، وهو ما يشير إلى وجوب الانتقال الى انتاج محاصيل تتقبل الجفاف. في الوقت نفسه، إن زيادة الأمن المائي من شأنه تحفيز المزارعين على زرع محاصيل ذات قيمة أعلى لعدة سنوات، مثل العنب، الذي يحتاج إلى ضمان الأمن المائي، مما يفسح المجال لزراعة المحاصيل التي تسمح بتراكم رأس المال الزراعي (أي الأشجار والنباتات الأخرى التي تستغرق وقتا كبيرا لتنضج) ، والتي هي أكثر ربحية من محاصيل موسم واحد (Lavee، 2010).

النفايات

تساهم النفايات البلدية الصلبة في تفاقم المشاكل البيئية والصحية في الأراضي الفلسطينية المحتلة، حيث إدارة النفايات لا تزال في مهدها. إن معظم النفايات في الأراضي الفلسطينية المحتلة (حوالي 69 ٪) يتم التخلص منها برميها في المكبات العشوائية والتي عادة ما تكون قد بدأت كمناطق تفريغ مؤقتة من قبل بعض السكان المحليين، ومن ثمّ اخذت بالتوسع تدريجياً. فهذه المكبات، إن لناحية الموقع او التركيبة، لا تخضع لأدنى معايير الصحة او البيئة. ويقدر وجود نحو 450 مكباً غير شرعي في الأراضي الفلسطينية المحتلة. وتواجه إدارة النفايات في الأراضي الفلسطينية المحتلة العراقيل لاسباب عديدة، مثل انعدام البنية التحتية لجمع النفايات ومعالجتها (مطامر قليلة فقط تم تشييدها بحسب المعايير الدولية، وعملياً لا يجري العمل بإعادة التدوير)؛ وقصور في الوعي العام حول التخلص من النفايات والمخاطر الصحية المرتبطة بها؛ مؤسسات حكومية ضعيفة ونقص في التمويل؛ عزل للأراضي مقرون باستمرار انقطاع الخدمات العامة بسبب الاحتلال الإسرائيلي. كل هذا يؤدي الى مشاكل بيئية متنوعة، مثل تلوث التربة والمياه الجوفية أو إنبعاث الغازات الضارة ، فضلاً عن انتشار الأمراض والروائح الكريهة ، وغيرها.

على مدى العقد الماضي، بذلت جهود عديدة لتحسين إدارة النفايات الصلبة، مثل بناء العديد من المطامر في قطاع غزة والضفة الغربية، ويعود ذلك الى حد كبير الى الدعم المقدم من المانحين. بالإضافة إلى ذلك، أصدرت السلطة الفلسطينية استراتيجية وطنية لإدارة النفايات الصلبة لـ2010-2014. غير أن تنفيذ هذه الخطة يعتمد، إلى حد كبير، على قابلية زيادة كبيرة في القدرات المؤسسية التي من شأنها تعزيز التشريعات وتعبئة الأموال (داخلياً وخارجياً).

هناك العديد من الفوائد الاجتماعية والبيئية والفوائد الاقتصادية والصحية لتحسين إدارة النفايات، بما في ذلك انخفاض معدلات تلوث الهواء من مكبات النفايات، وخاصة عندما تشتعل هذه المكبات أو يتم حرقها عمداً، فتنبعث منها الغازات السامة والمسببة للسرطان. ومن الفوائد الأخرى لتحسين إدارة النفايات، خفض الراشح من مكبات النفايات المتروكة من

دون إدارة، وتلوث التربة والمياه الجوفية المرتبطة بها. وأخيراً، تخفف الإدارة السليمة للنفايات من تعرض السكان للامراض التي تنقلها الحشرات والحيوانات (القوارض مثلا). وتشتمل الفوائد الاقتصادية لإدارة النفايات السليمة على خفض تكاليف الرعاية الصحية من جراء تنقية الهواء وتحسين جودة المياه وتجنب الأمراض، إضافة الى عائدات المواد المعاد تدويرها وتحويلها إلى سماد عضوي والتي يمكن استخدامها كمواد خام ثانوية.

فائدة أخرى تتمثل في خفض انبعاثات غاز الميثان. إن النفايات القابلة للتحلل يمكن ان ينبعث منها كميات كبيرة من غاز الميثان، وهو غاز دفين لديه قدرة اعلى من غاز ثاني اكسيد الكربونCO_2 على التسبب بالاحتباس الحراري العالمي. هناك العديد من التكنولوجيات المتاحة لالتقاط غاز الميثان من النفايات القابلة للتحلل (الكتلة الحيوية) من أجل الإنارة ، أو لإنتاج الطاقة من حرق غاز الميثان. وهذا من شأنه خفض الانبعاثات التي لولاها لكانت تنبعث في الغلاف الجوي، وتساعد على تقليل الاعتماد على الوقود الأحفوري لإنتاج الطاقة. وبحسب التقديرات الواردة في هذه الدراسة، يمكن تجنب او حبس غاز الميثان بقدر 9,145 مليون متر مكعب. وحيث ان غاز الميثان لديه إمكانات الاحتباس الحراري العالمي أقوى بكثير من غاز CO_2 (بعامل 21)، فإن انبعاثات غاز الميثان تعادل 2,08 مليون طن من غاز CO_2 معدلاً. إن تجنب هذه الانبعاثات يمثل فائدة نقدية بقيمة تتراوح بين 116,6 - 41,7 مليون €.

الطبيـعة والتـنوع البيولوجي

تقع الأراضي الفلسطينية المحتلة في مناطق جغرافية ذات تنوع بيولوجي فريد بين أوروبا والقارات الآسيوية والأفريقية، والبحر الأبيض المتوسط والبحر الأحمر. نتيجة لهذا الوضع المميز، تتمتع المنطقة باوساط طبيعية ذات تنوع بيولوجي عالي داخل منطقة صغيرة نسبياً. إلا انه، في حين أن هذه النظم الإيكولوجية تدعم مجموعة من الأنشطة البشرية وتدر منافع بطرق مختلفة (بما فيها الزراعة، وتربية الحيوانات، والغابات، والمنتجات الصحية التقليدية، وغيرها)، فإن هذه الفوائد تفتقد، إلى حد كبير، الى التقييم الاقتصادي والتقدير النقدي.

هناك عدد من الضغوط لا تزال تؤثر على الموائل الطبيعية في فلسطين، وهي: التوسع العمراني العشوائي، والرعي الجائر ، والإفراط في الاستغلال، وإزالة الغابات والأنشطة الحرجية الارتجالية، والتصحر والجفاف، وتآكل التربة، والصيد، وأنواع إحيائية غريبة عدائية، والتلوث. إن اي حل فعّال قد يطرح لإزالة هذه التهديدات، يواجه تعقيدات ظروف الاحتلال الاسرائيلي (بما في ذلك عدم السيطرة على الأرض وموارد البلاد الطبيعية، والمستوطنات، والطرق الجانبية، والمناطق العسكرية المغلقة، والجدار العازل، الخ...)، مما يحد من قدرة السلطة الفلسطينية على تنظيم استخدام الأراضي، ومراقبة الوضع البيئي بشكل صحيح وتطبيق الإجراءات التي من شأنها حماية البيئة.

إن الفوائد التي يمكن قياسها كماً بشكل تقريبي تشمل قيمة الأراضي الزراعية بعد الحد من تدهورها، والتي تتجلى في زيادة المحاصيل من جرّاء تحسين إدارة الأراضي. وتقدر هذه الفوائد بـ 68 -41 مليون PPP € (الفوائد السنوية اعتبارا من عام 2020 ، فيما لو تحقق الهدف البيئي). وهذا يعادل 0,48-0,29 % من الناتج المحلي الإجمالي المتوقع في عام 2020.

كذلك، بالامكان تقدير فوائد وقف إزالة الغابات (او إزالتها) بشكل تقريبي من خلال قيمة الغابات كمخزون للكربون. إن ازالة الغابات في الأراضي الفلسطينية المحتلة تتم بمعدل 0,8 ٪ سنوياً. وإذا كان من الممكن خفض هذا المعدل إلى الصفر بحلول عام 2020 (أي وقف إزالة الغابات بعد عام 2020)، فإن قيمة الربح السنوي ستصل إلى 14,6 € فقط من حيث الكمية المحتجزة من CO_2 في الغابات. هذا ليس سوى تقدير تقريبي لقيمة الغابات الاقتصادية الإجمالية، إذ ان مثل هذه التقديرات اخفقت بتغطية فوائد هامة متصلة باستخدام او عدم استخدام الغابات، نذكر على سبيل المثال: منتجات الغابات الخشبية وغير الخشبية، والاستخدامات الترفيهية، وخدمات النظام الإيكولوجي، مثل المياه وتنقية الهواء وحماية التربة من التآكل، الخ.

تغّير المناخ

تواجه فلسطين، كغيرها من دول العالم، تحديات ناجمة عن تغيّر المناخ. ومع وجود المشاكل المتصلة بندرة الموارد المائية في كل من الضفة الغربية وقطاع غزة، يبدو أن الموارد المائية هي الأكثر عرضة لتغير المناخ والتي سوف تزداد تدهوراً بنتيجته. هذا من شأنه ان يؤثر بشدة على كل من قطاعي الزراعة والصحة، وبالتالي سوف يقلص الامن الاقتصادي والمائي والغذائي. إن سبل معيشة المزارعين، وخاصة المجتمعات الريفية الزراعية البعلية، هي دائما متضررة على نحو

مباشر من هطول الأمطار وانتشار الجفاف، فضلا عن تزايد أحداث الطقس المتطرفة (موجات الحرارة والعواصف، الخ). في حين لا يوجد تقييم مفصل للتأثير المحتمل لتغير المناخ، يمكن ملاحظة بعض التغيرات في نمط هطول الأمطار خلال العقد الماضي، ولقد نسبت السلطات الفلسطينية هذه التغييرات لظاهرة تغير المناخ. ومن المتوقع تفاقم مشاكل ندرة المياه في الأراضي الفلسطينية المحتلة بسبب تغير المناخ. هذا بالإضافة إلى ان النقص في المياه قد ينتج زيادة في المشاكل الصحية، مثل الإسهال والكوليرا والجفاف. كما ان خطر الإصابة بأمراض طفيلية قد يزداد مع تغير المناخ.

هناك وعي متزايد للآثار المحتملة لتغير المناخ تم توثيقه في ورقة استراتيجية التكّيف مع تغير المناخ وبرنامج عمل للسلطة الفلسطينية، والذي تم إعداده بالاشتراك مع برنامج الأمم المتحدة الإنمائي وهيئة جودة البيئة في نهج تشاركي اشتركت فيه جميع الجهات المعنية ذات الصلة. علاوة على ذلك، لا تزال هناك كمية محدودة من المعرفة-النموذج القابل للقياس الكمي حول تأثيرات تغير المناخ في الأراضي الفلسطينية المحتلة، والنتائج الاجتماعية والاقتصادية الناجمةعنه والتي يمكن أن تدعم صياغة مثل هذه الإستراتيجية في المستقبل.

لما كان نصيب الفرد الفلسطيني من الانبعاثات منخفض نسبياً وفقاً للمعايير الدولية، فإن التخفيف من انبعاثات غاز الاحتباس الحراري لم يحظى بالاهمية المطلوبة لكي يدرج على جدول أعمال السياسة البيئية. ومع هذا، ابدت السلطة الفلسطينية في السنوات الأخيرة اهتماماً متزايداً في مجال تطوير مصادر الطاقة المتجددة، والذي يمكن عزوه الى الفوائد المشتركة لنشر مصادر الطاقة المتجددة : بالاضافة الى خفض انبعاثات الغازات المسببة للاحتباس الحراري، فهي تساعد أيضا في تقليل الاعتماد على الوقود المستوردة والكهرباء، ويمكن استخدامها لدعم كهربة الريف والمناطق النائية، وتتضمن تكاليف خدمات الطاقة. حالياً، 80 ٪ من الطاقة المستهلكة في الأراضي الفلسطينية المحتلة تعتمد على الوقود الأحفوري من نوع الكهرباء والمنتجات النفطية، والتي هي بالكامل تقريبا مستوردة من إسرائيل، الامر الذي يخلق عائقاً خطيراً في الأراضي الفلسطينية المحتلة امام وضع سياستها الخاصة بالطاقة، وفي الوقت نفسه، يشكل حافزاً قوياً لتطوير مصادر الطاقة المحلية. تشكل الطاقة المتجددة حالياً حوالي 18 ٪ من استهلاك الطاقة النهائي في الأراضي الفلسطينية المحتلة، ويتم ذلك وبشكل رئيسي عن طريق سخانات المياه الشمسية المثبتة على نحو 60 ٪ من المساكن. هذا، إضافة الى العديد من المبادرات المتفرقة لنشر الخلايا الضوئية أو توربينات الرياح في المناطق الريفية. وعلى الرغم من ذلك، لا تزال هناك فرص كبيرة في الأراضي الفلسطينية المحتلة لنشر المزيد من السخانات الشمسية، أو استخدام النفايات العضوية لإنتاج الغاز الحيوي. وتماثلاً مع غيرها من مجالات السياسة، فان ما يعوق نشر الطاقة المتجددة هو الافتقار إلى تنسيق في السياسات والقدرة على تعبئة الأموال اللازمة لهذه الاستثمارات الأولية.

لقد تطرقت هذه الدراسة الى اثنين من سيناريوهات السياسة التي من شأنها زيادة حصة الطاقة المتجددة من نسبة 18 ٪ الحالية إلى 25 ٪ بحلول عام 2020 في السيناريو ألاقل طموحاً، وإلى 30 ٪ في عام 2020 في السيناريو الأكثر طموحاً. إن السياسات المعتمدة في هذه الحالات ستخفض انبعاثات CO_2 ما بين 344996 و 589930 طن سنوياً، بالمقارنة مع العمل المعتاد. استناداً إلى ثلاثة تقديرات لسعر الكربون في السوق العالمية، يمكن تقدير الفوائد بالوحدات النقدية والتي تبلغ سنوياً ما بين 7 و 19 مليون € لسيناريو 25 ٪ من الطاقة المتجددة المستهدفة. اما الفوائد النقدية السنوية لسيناريو 30 ٪ من الطاقة المتجددة المستهدفة فتبلغ ما بين 11,8 و 33 مليون €.

يوفر الجدول التالي ملخصاً عن الفوائد الرئيسية التي تم تقييمها ضمن المشروع في مختلف المواضيع.

ملخص الفوائد الرئيسية السنوية بحسب المواضيع

	الفوائد النوعية	**الفوائد الكمية**	**الفوائد النقدية**
الهواء	**الصحية :** تقليص الأمراض التنفسية **البيئية** : تقليص الضرر الذي يصيب النظم الإيكولوجية والمحاصيل **الاقتصادية** : تحسين الانتاج الزراعي وخلق وظائف في مجال التكنولوجيا الخضراء **الاجتماعية** : خفض الأضرار التي تلحق بالمباني والتراث	تجنب أثر تلوث الهواء على الصحة (خفض حالات الامراض التنفسية): 220 حالة تجنب للوفيات المبكرة، 440 حالة تجنب للامراض	فوائد صحية سنوية بقيمة: (خفض في الوفيات والامراض): 68 مليون € PPP
المياه	**الصحية** : تقليص الأمراض المنقولة بالمياه **البيئية** : تحسين نوعية المياه في الأنهر والساحل، و	1,2 مليون نسمة تم شبكهم بانابيب توصيل مياه آمنة	الأثر الصحي لتجنب الامراض: فوائد صحية

	الفوائد النوعية	الفوائد الكمية	الفوائد النقدية
	تخفيض التخثث **الاقتصادية** : تخفيض تكاليف المياه النظيفة للصناعة، والفرص المتاحة من معالجة المياه المبتذلة واستخدامها في الزراعة، وزيادة رضا السياح **الاجتماعية** : تحسين الظروف المعيشية خصوصا في الحد من معدلات الفقر.	وموثوقة ؛ و 1,9 مليون نسمة اضافي تم توصيلهم بشبكات الصرف الصح؛ تجنب 1,6-1,2 مليون حالة اسهال و تجنب 88-193 حالة وفاة؛ 5,25 مليون نسمة تم شبكهم على الاقل بمحطات ثانوية لمعالجة المياه؛ 87,9 متر مكعب من المياه المبتذلة تم معالجتها في المحطات الثانوية.	سنوية بقيمة: 99-45 مليون PPP €
النفايات	**الصحية**: خفض الأمراض التي تنقلها المياه الملوثة بالنفايات بالقرب من مجاري المياه ورداءة البيئة الصحية **البيئية** : خفض الحد من تلوث التربة والمياه السطحية والجوفية وتحسين نوعية الهواء، وخفض في انبعاث الغازات الدفيئة **الاقتصادية** : زيادة فرص العمل المحلية في قطاع النفايات، زيادة رضى السياح، امكانات جديدة لإنتاج الطاقة من النفايات **الاجتماعية**: تحسين الظروف المعيشية خصوصا بالنسبة للفقراء.	تحويل النفايات العضوية بعيداً عن المطامر وحبس غاز الميثان المنبعث من المطامر: تجنب تنشق 146 مليون متر مكعب من غاز الميثان ما يعادل 2,08 مليون طن من غاز CO_2	تجنب تنشق 146 مليون متر مكعب من غاز الميتان ما يعادل 2,08 مليون طن من غاز CO_2 يمثل فائدة سنوية بقيمة تتراوح بين 41,7 – 116,6 مليون €
الطبيعة	**الصحية** : فرص للاستجمام والاسترخاء ، والمساهمة في الحد من الأمراض المنقولة بالمياه **البيئية** : خدمات النظام الإيكولوجي -- مثل تنقية المياه وتخزين الكربون ، وتوفير الغذاء ، وانخفاض تآكل التربة الخ **الاقتصادية** : السياحة البيئية ، وتحسين المحاصيل الزراعية **الاجتماعية** : فرص للتعليم والبحوث ، والشعور بالانتماء.	وقف ازالة الغابات الحالي بحلول 2020 – تجنب انبعاث 726,000 من غاز CO_2 من مخزون الغابة	الحد من خسائر المحاصيل جراء تدهور الاراضي الزراعية: 41-68 مليون € سنوياً . الفائدة من وقف إزالة الغابات: 14,6 – 40,6 مليون € فقط من غاز CO_2 المحبوس
تغير المناخ	**الصحية** : المساهمة في الحد من أمراض الجهاز التنفسي **البيئية** : خفض التأثيرات الناجمة عن تغير المناخ على البيئة ، وانخفاض ملوحة التربة و المياه ، الخ.) **الاقتصادية** : خفض الأضرار التي تلحق بالإنتاجية الزراعية والسياحة الساحلية **الاجتماعية** : أمن الطاقة ، وتوفير الطاقة للمناطق المعزولة من خلال الطاقة المتجددة، توافر المياه (مزيج بين الطاقة المتجددة وتحلية المياه) ، وتقليل النزوح السكاني .	زيادة حصة الطاقة المتجددة الى 25% او 30% بمقابل تخفيض استهلاك موارد الطاقة الاحفورية بين 128-216 طن من النفط	الفوائد السنوية لخفض انبعاث غاز CO_2 بقيمة تتراوح بين 7-19 مليون € لمجموعة 25% من الطاقة المتجددة المستهدفة، وبقيمة تتراوح بين 11,8 – 33 مليون € لمجموعة 25% من الطاقة المتجددة المستهدفة

ANALYSIS FOR ENPI COUNTRIES ON SOCIAL AND ECONOMIC BENEFITS OF ENHANCED ENVIRONMENTAL PROTECTION

Country report: occupied Palestinian territory

1 INTRODUCTION

1.1 This report

The European Union, represented by the European Commission contracted a consortium led by ARCADIS Belgium N.V. to undertake an assessment of the social and economic benefits of enhanced environmental protection for the 16 countries covered by the European Neighbourhood Policy (ENP) and the Russian Federation. The other consortium partners are: Institute for European Environmental Policy (IEEP), Ecologic Institute, Environmental Resources Management Ltd. and Metroeconomica Ltd.

The overall aim of the project is to move environmental issues higher up on the political agenda. Its specific objectives are to improve awareness of the benefits of enhanced environmental protection in the countries studied, and of their capacity to assess these benefits. In this way, the project is meant to encourage each country to integrate environmental considerations into policy making and to mobilise the necessary financial resources for improving the state of the environment.

This report provides an assessment of the environmental, social, health and economic benefits of environmental improvements in the occupied Palestinian territory.

This report has been prepared on the basis of information gathered during a country mission, which was undertaken by the project's experts in the period 28 September – 2 October 2010, and during follow-up meetings with country officials, complemented with a desk review of national and international databases and reports. The report has also benefitted from discussion with country officials at the final event of this project on 28 and 29 June 2011, and a round of written commenting by country officials following this event.

1.2 What are environmental benefit assessments?

An environmental benefit assessment examines the potential positive outcomes for society that result from the adoption of environmental protection targets and the implementation of environmental actions to meet these targets. Such actions may include environmental policies, legislation and investments undertaken by government, industry or other stakeholders that lead to environmental improvements (e.g. improved water quality from the construction of wastewater treatment plans).

The environmental benefit assessment undertaken for the occupied Palestinian territory comprises the following elements:

– a description of the current status of the environment and how this is expected to change given current projected trends in socio-economic factors (mainly GDP growth and demographic changes);
– an assessment of the potential direction and magnitude of environmental change if specific environmental targets were achieved;
– the identification, and where practical, quantification and monetisation of the benefits arising from such an environmental change.

The methodology applied for the country benefit assessments was developed under the project, building on previous analyses and methodologies, in particular on IEEP's ENP methodology (ten Brink and Bassi, 2008) and the World Bank's Cost of Environmental Degradation (COD) reports.

The methodology applied in this study is described in greater detail in a Benefit Assessment Manual. This document has been developed for internal use by the project experts that conducted the country benefit assessments. On the basis of this internal Benefit Assessment Manual and the experiences gained in its application, a Benefit Assessment Manual has been developed for a wide audience of policy makers in the ENP countries.[4] Estimates and calculations by the authors in this report are made on the basis of the methodologies described in this Manual.

1.3 Aims of the country benefit assessments

This benefit assessment report intends to help the country to evaluate the benefits of addressing environmental challenges it is facing and, where possible and appropriate, estimate their economic value – hence making benefits comparable and understandable to a wide audience. The assessment provides "order of magnitude" results, in order to communicate the scale and significance of the potential benefits of taking action.

This benefit assessment report aims to assist policymakers by providing new evidence and values on:

– key environmental issues affecting their country, i.e., the issues that could result in the greatest benefits if tackled appropriately;
– impacts of these issues on society – i.e., in terms of social (e.g., health), economic (e.g., additional social costs) and environmental (e.g., biodiversity loss) impacts; and
– benefits (health, environmental, economic and social) that accrue to society from taking actions to protect the environment.

4 Bassi et al, 2011): Bassi, S. (IEEP), P. ten Brink (IEEP), A. Farmer (IEEP), G. Tucker (IEEP), S. Gardner (IEEP), L. Mazza (IEEP), W. Van Breusegem (Arcadis), A. Hunt (Metroeconomica), M. Lago (Ecologic), J. Spurgeon (ERM), M. Van Acoleyen (Arcadis), B. Larsen and, F. Doumani. 2011. Benefit Assessment Manual for Policy Makers: Assessment of Social and Economic Benefits of Enhanced Environmental Protection in the ENPI countries. A guiding document for the project 'Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection'. Brussels.

This benefits assessment report can also play an important role in raising awareness regarding environmental problems, impacts and the benefits of action. The latter is crucial, as policy makers have often a clearer perception of what it costs to maintain the quality of the environment, than of the resulting benefits.

1.4 Potential users of and target audience for this benefit assessment report

The potential users of and the target audience for this benefit assessment report include:

- Governmental institutions, responsible for a sector that will directly benefit from environmental improvements, such as the ministries responsible for environment, water, energy, land use, agriculture, fisheries, health, social affairs and tourism. This report provides evidence of the benefits of environmental improvements that can support their arguments for funding environmental actions and for environmental policy integration[5].
- Regional and local authorities, for similar reasons as the above mentioned governmental institutions.
- Finance ministries, which often play an important role in deciding the funding levels for each other ministry, are also a potential user of benefit assessments. This is important, as it is the perceived benefits that drive policy decisions to allocate public resources to maintain and to improve the quality of the environment.
- Parliament: this report can help legislators responsible for environmental matters to make the case for better environmental protection and conservation legislation.
- The Judiciary (ministries of Justice) and environmental inspectorates/enforcement agencies. This report provides evidence that supports their arguments for enforcing environmental legislation.
- Communities: this report can help communities that depend for their livelihood on natural resources (e.g., forestry, fisheries) to demonstrate the value of the resources and the importance of preserving them, community management of community resources.
- The private sector, civil society and the development partner community, which jointly work on the common challenge of the transition to a resource efficient, effective, green and equitable economy. This report can help them to set priorities for action and provides evidence when advocating for enhanced environmental protection.

1.5 The benefits of an improved environment

The country benefit assessment focuses on four categories of benefits from environmental improvements:

5 Environmental integration means making sure that environmental concerns are fully considered in the decisions and activities of other sectors, such as agriculture, tourism, industrial development, energy or transport.

- **Health benefits**: these can also be interpreted as social benefits, but given the strategic importance to health of the enhanced environmental protection, they are assessed as a separate category. Direct benefits to public health include for example:
    - a reduction in the cases of illness and the avoidance of premature mortality arising from water-borne diseases,
    - a reduction in respiratory and cardio-pulmonary diseases and premature mortality associated with poor air quality.

- **Economic benefits**: benefits include for example:
    - economic benefits from natural resources (e.g. tourism benefits relating to protected areas, landscape, beaches, coral reefs),
    - eco-efficiency gains (e.g. improved fish provision from enhanced ecosystems that support fisheries directly and indirectly),
    - avoided costs (e.g. avoided costs of hospitalisation and lost days at work from health impacts; avoided climate change impacts),
    - the development of new and existing industries/sectors of the economy (e.g. renewable energy),
    - balance of payments and trade effects (e.g. reduced imports of primary material as more waste is reused and recycled),
    - increased employment through environmental investments (e.g., potential from developing the waste collection sector, from growth in eco-tourism).

- **Environmental benefits**: are the positive impacts on the natural environment of meeting environmental targets. For example, if the target of secondary treatment of all urban waste water would be reached, this would result in environmental benefits, such as improved surface water quality and avoidance of eutrophication, that can lead to biodiversity loss.

- **Social benefits:** benefits to individuals and society at large, including for example:
    - the safeguarding of, and access to, the natural and cultural heritage (avoided pollution damage to historic buildings or the destruction of historic landscapes),
    - recreational opportunities (e.g., fishing and bathing),
    - benefits of trust in quality environmental service provision (e.g., water quality),
    - social cohesion due to support for employment, social learning and the development of civil society (due to increased information provision, consultation and involvement).

1.6 Scope of the country benefit assessment

The improvement of environmental conditions encompasses a vast range of environmental areas and policies. Since it was not possible to cover all these aspects, the analysis focused on a selection of the key environmental issues on which the analysis should focus.

The aim was to identify issues of importance which are sufficiently representative of the five environmental themes covered by the project, i.e. air quality, water quality, waste, nature and biodiversity and climate change (as a cross-cutting policy with several interlinkages). These policy fields are common concerns across all the countries covered by this project, and are sufficiently well-understood to be assessed rigorously.

To structure the analysis, the five themes were further subdivided into nine *sub-themes*, and for each of these sub-themes, specific *parameters* were identified that form the core of the analysis. There are a total of 14 parameters, with two parameters occurring in two themes. The benefit assessments are about assessing the benefits of improving the state of the environment for each of these parameters.

Table below provides an overview of the themes, subthemes and parameters.

Table 1-1Overview of themes, sub-themes and parameters

THEME	SUB-THEME	PARAMETER
AIR	Air quality	Ambient air quality
WATER	Water - infrastructure and practice	Connection to safe drinking water
		Connection to sewage network and hygiene conditions
		Level of waste water treatment
	Water - natural resources	Surface water quality
		Water resource scarcity
WASTE	Waste collection	Waste collection coverage
	Waste treatment	Waste treatment
		Methane emissions from waste
NATURE	Biodiversity	Level of biodiversity
	Sustainable use of natural resources	Deforestation levels
		Level of cropland degradation
CLIMATE CHANGE	Climate change drivers	Deforestation *(covered under nature)*
		Methane emission from waste *(covered under waste)*
	Climate change responses	Uptake of renewable energy sources
		Climate change adaptation (responses to a selection of 2-3 impacts)

1.7 The level of analysis

The benefit assessments provide “order of magnitude” results, in order to communicate the scale and significance of the potential benefits.

The benefits arising from improved environmental conditions can be analysed in three ways: qualitatively, quantitatively and in monetary terms.

- In qualitative terms, providing a description of the nature of the benefit, the people, land areas, sectors and services affected, based on the views of stakeholders, published assessments and expert judgement. This approach requires least data, and is applicable to all the parameters analysed.

- In quantitative terms, whenever quantitative data are available (e.g., cases of morbidity/mortality avoided, etc), to indicate the actual, relative or proportionate scale of the benefit arising from the environmental improvement identified. For example, the improvement of ambient air quality can lead to a quantifiable reduction in the likely number of cases of respiratory disease and associated morbidity or early mortality. This approach is applicable to several but not all the parameters, depending on the data available and the possibility to link environmental improvements to actual physical effects.

- In monetary terms, when possible. This third approach multiplies the quantitative benefit identified by a standard economic value (or ranges) representing the monetary value for society of a certain environmental improvement. Where possible, such assessments were based on values obtained from local studies; in other instances, assessments used standard reference values from the literature or values from studies conducted elsewhere, adjusted for differences in key socioeconomic characteristics.

Such value can for instance be:

- The amount of money saved if a certain improvement is made (e.g., avoided hospitalisation costs from avoided illness; reduced cost for water purification if the quality of water improves),
- Market values of products or savings (e.g., increased fish output, carbon storage) or
- A measure of people's willingness to pay (WTP) for a benefit (e.g., access to improved bathing water quality).

Such economic values may be obtained from:

- Cost data for specific services (*e.g.,* hospital treatments for particular diseases),
- Market values for particular commodities (e.g. fish, carbon),
- Survey data documenting actual willingness to pay responses,
- Modelling studies,
- Applying the benefit transfer method (i.e. drawing upon valuation study results calculated elsewhere, that value similar changes, and adjusting for socioeconomic differences between the study site and the policy site).

Most benefits are identifiable in qualitative terms, but due to data availability, only a subset of them in quantitative terms and a smaller set in monetary terms.

The adoption of this three-level approach is important as the availability of suitable data varies from one parameter to another. The purpose of this three-stage approach is to ensure that the full range of benefits of enhanced environmental protection is realised, and that the benefit assessment is not constrained by focusing only on the elements that can be quantified or monetised.

In general, the aim is to have a nation-wide picture for each parameter, but in some cases, local case examples can be valuable to help communicate particular benefits. To this extent, a case study has been included in this report for the benefits of improved wastewater treatment, using the example of locally produced small-scale on-site wastewater treatment units that provide benefits not only in terms of water quality improvements, but also by generating local employment.

1.8 Assumptions

A number of assumptions have been made to carry out the country benefit assessment. Parameter specific assumptions are included in the relevant sections of this report. General assumptions, across parameters, are summarised in Table 1.2. It should be noted that a practical approach with limited sensitivities has been chosen for this study in order to keep the analysis relatively simple.

Table 1-2: Summary of key assumptions for ENP benefits studies

Issue	Assumptions
Timescale	2020
Reference year	2008 if and where data available, and note year if other than 2008.
Targets	Usually a single common target for the year 2020 that was used across all the countries analysed, for each parameter under analysis.
Baseline	Usually a set of essential factors are included in the baseline projection, such as GDP, population and their growth rates. These are kept to a minimum to keep the analysis reasonably simple.
Adjustment of monetary values for Purchasing Power Parity (PPP)	Monetary values Euros are adjusted for Purchasing Power Parity (PPP), except for the carbon prices used as regards climate change mitigation, which are in €. Monetary values calculated for e.g. health benefits associated with avoided impacts of air pollution, or other benefits, are thus in € PPP. PPPs are widely used as an alternative to monetary exchange rates when making international economic comparisons. They are, in effect, "real" exchange rates, based on a comparison of the relative purchasing power of each country's currency. Purchasing power parities equate the purchasing power of different currencies. This means that a given sum of money, when converted into different currencies at the PPP rates, will buy the same basket of goods and services in all countries, thus eliminating differences in retail price levels between countries.

	To convert current-day Euro values into local currency (New Israeli Shekel), the following exchange rates were used: PPP-adjusted exchange rate: 5.24 NIS/Euro (2008); market rate: 5.26 NIS/Euro (2008).6 All prices are expressed as 2008 prices, unless otherwise indicated.
Mortality and morbidity	Improvements in e.g. ambient air quality, drinking water, sanitation and hygiene are associated with reductions in the risk of mortality. The benefits to society of mortality risk reductions are usually valuated by people's willingness-to-pay (WTP) for such risk reductions. WTP is then converted to a value of statistical life (VSL) that is applied to estimated cases of mortality avoided from the environmental improvements to arrive an estimate of the monetary benefits of the improvements. The VSL varies across countries in proportion to GDP/capita (PPP terms)[7]. It should be emphasized that these VSLs have nothing to do with value of life, but rather reflects how people are willing to reallocate their resources from consumption of market goods and services to paying for reductions in the risk of mortality. The same WTP and benefit transfer approach is used for valuing an avoided case of illness, unless otherwise stated.
Time development of willingness to Pay (WTP)	Assumes a proportional relationship – e.g., if GDP/capita increases by a factor of 2, the WTP also increases by a factor of two.

The annual growth rate values used to estimate the projected 2020 values are given in Table 1-3. These are default values based on OECD estimates. For simplicity the same factors have been used for macro regions (ENPI South, ENPI East and Russia) under the broad assumption that these will face similar socio-economic developments. For the waste parameters, different values have been used and are referenced in the appropriate sections.

Table 1-3 Annual growth rates

Country cluster	Data	Annual growth factor
ENP South	population	1.68%
	GDP	3.75%
	GDP/capita	2.03%
ENP East	population	0.02%
	GDP	3.35%
	GDP/capita	3.33%
Russia	population	-0.55%
	GDP	3.75%
	GDP/capita	4.32%

6 World Bank. 2011. World Development Indicators

7 An empirically estimated function from a recent meta-analysis of studies of VSL in over 30 countries (of which nearly half are countries with a GDP per capita in the range of that of the ENPI countries) by Navrud and Lindhjem (2010) prepared for the OECD are used to estimate VSL in ENPI countries (www.oecd.org/env/policies/VSL).

Where: ENP South = Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Syria, Tunisia, West Bank and Gaza
ENP East = Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine
Russia = Russian Federation
Source: unless otherwise indicated in this report, GDP projections are based on the GDP projections used in the global modeling runs (using the Globio-Image model) for the OECD 2008 Global Outlook to 2030 report[8].

Full reference to the specific values used for factors such as GDP, population, growth rates and Values of Statistical Life for each country, as well as Willingness to Pay values and carbon values common across all countries have not been included in this report, but can be found in the Benefit Assessment Manual that was developed for this project.

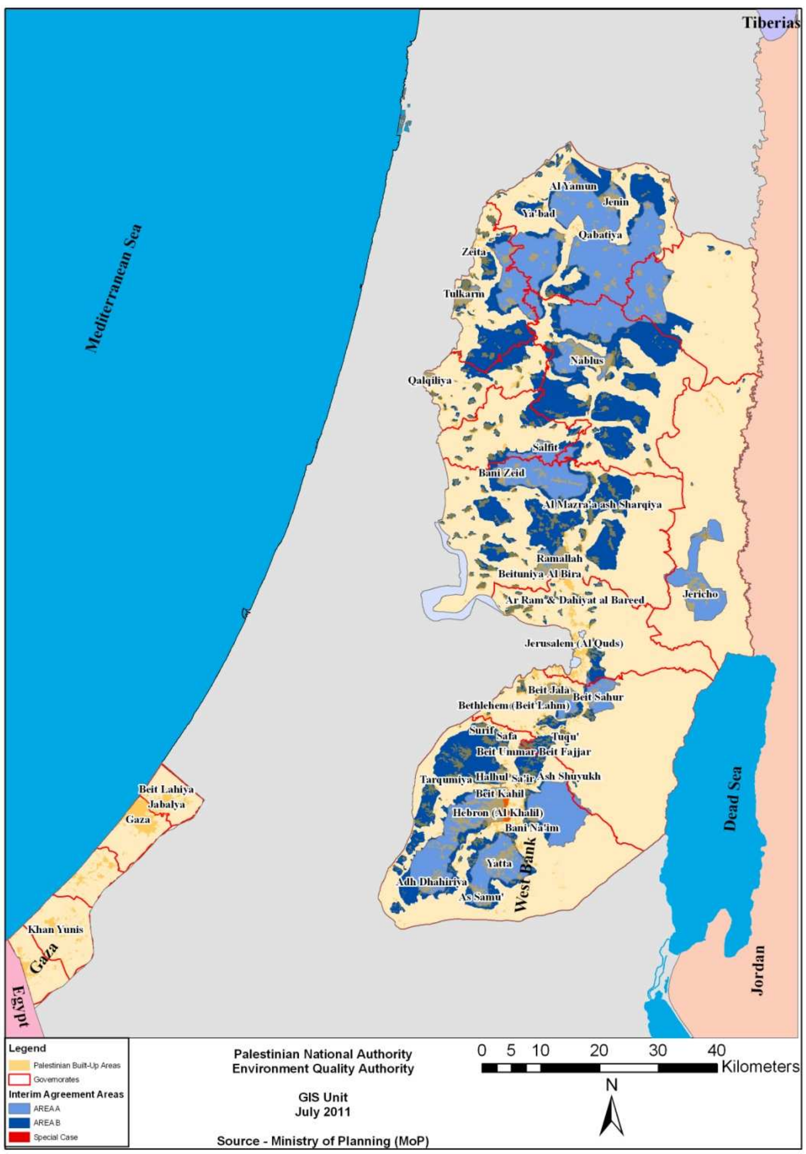
[8] OECD (2008) *Organisation for Economic Cooperation and Development: Outlook to 2030.*Paris.

2 COUNTRY OVERVIEW: OCCUPIED PALESTINIAN TERRITORY

2.1 Environment, economy and society

The situation in the occupied Palestinian territory (oPt) is unique in the sense that the Palestinian National Authority (PNA) has only limited control over its own territory. Consequently, the Israeli occupation and its consequences both dominate other internal policies, including environmental policies, and also limit the scope for action by the Palestinian National Authority (PNA).

Figure 2-1 Distribution of Areas A, B and C within the oPt



Source: Ministry of Planning

The Israeli occupation affects the oPt environmental policy in two ways: first; the Israeli settlements and the military infrastructure in the West Bank exert pressures on the environment (in terms of water abstraction, generation of wastewater and solid waste, transboundary air pollution, and the use of land). For the Gaza strip, the Israeli occupation still controls the land and sea borders. Secondly, the statutes of the occupation (as laid out in the Oslo agreement) limit the PNA's ability to effectively address the environmental problems they are facing. In line with the Oslo agreement, the PNA only has authority to make decisions on the 2.7% of the West Bank that fall under the “Area A” and – within limits – the 25.1% under “Area B”. For majority of the territory (72.2%) that belongs to the “Area C”, the PNA has no control. This has very practical implications for decisions like designating nature reserves and protected areas, establishing landfills, or constructing sewage treatment plants. Often, such projects can only be undertaken in the “Area C”, as areas A and B are typically densely populated, built-up areas. However, any projects in Area C require the consent and cooperation of Israeli Authorities. The PNA’s control over the Gaza strip, again, is limited by the political fallout between the Fatah-lead Palestinian government in the West Bank, and the Hamas-lead administration in Gaza. This means that the PNA’s authority and control over the Gaza strip is ineffective; the PNA’s organs in Gaza are effectively dysfunctional at the current time.

Table 2-1 Key economic indicators for the occupied Palestinian territory

Indicator	Most recent year (unless otherwise specified)
Country surface area	6,020 km^2
Population size	Current: 3,937,309 Projections (2020): 5,454,000
Population and growth rate	Current: 2.71%
Number of households	Current: 624,97
GDP (EUR)	EUR 3,226,337,853 (2005)
GDP/capita (EUR prices)	EUR 902 (2005)
GDP growth rate	4.9%
Share (%) of forestry in GDP	0.03% (2000)
Share (%) of agriculture and fishery in GDP	8.2% (2007)
Share (%) of tourism in GDP	3-4% (2003)

Source: All data from World Bank, except share of forestry in GDP (PCBS, 2006), share of agriculture and fishing in GDP (PCBS, 2009) and the share of tourism in GDP (Paltrade, 2006). Due to strongly fluctuating GDP growth rates in the past years, the average of GDP growth rates from 2000 and 2008 was taken).

The following section provides a brief overview of the main environmental concerns that the occupied Palestinian territory faces, structured by the following environmental themes: air, water, waste, nature and climate change.

Air Quality

Among the different environmental policy domains, air quality is not regarded as a the most pressing issue in the oPt. This perception is also due to the fact that there is no power generation in the West Bank, and only one oil-fired power station in Gaza. Heavy industry is virtually absent both in the West Bank and Gaza. However, there are sources of air-borne emissions, such as the transport sector (in particular due to the aged fleet or cars and trucks), which is estimated to contribute about 40%-50% of the observed air pollution.

Further sources are the widespread unmanaged burning of solid waste, as well as dust emissions from stone quarries and stone crushing facilities (stones being one of the oPt most important export products). Moreover, common agricultural activities contribute to the problem by the daily application of methyl bromide and the burning of plastic sheet waste which are harmful to the ozone layer. In Gaza, the situation is worsened by the intensity of traffic and the high age of its cars (Palestinian Environmental Strategy 2000, ARIJ 2007).

A further source of air pollution is transboundary pollution from Israel and the Israeli industrial sites situated in the West Bank. Prevailing westerly winds carry significant amounts of pollution from Israel to the oPt. For industrial installations in Israeli settlements in the West Bank, Palestinian sources point to a concentration of dirty and polluting industries, as companies attempt to escape the stricter (or more meticulously enforced) environmental regulation in green-line Israel by relocating their operations to settlements in the West Bank.

Water

Water is the most prevalent issue on the Palestinian environmental agenda, while access to water is also among the most contentious points in the negotiations between Israel and the oPt. The Israeli occupation strongly influences the oPt water situation, both in terms of access to the available water resources, and by limiting the Palestinian National Authority's capacities to actively improve the situation (e.g. construction of wastewater treatment).

Gaza and the West Bank rely on groundwater for more than 95% of their water needs, as access to the only permanent river, the Jordan River, is denied to the Palestinians while precipitation is limited (500 – 600 mm per year on average) and concentrated in the months from December to March. In the Gaza Strip, scarcity and overuse reached critical levels which resulted in the intrusion of sea water into the Coastal Aquifers and a consequent deterioration in water quality. Contrary, with groundwater abstraction being largely within sustainable limits, the West Bank suffers from the uneven distribution of water between the oPt, Israeli settlements and green-line Israel, rather than from absolute water scarcity.

The wastewater treatment plants in the oPt are inadequate to serve the amount of wastewater being generated, with 58% of total generated wastewater being discharged without treatment to the environment. In addition to causing environmental degradation, groundwater quality is threatened and public health is endangered (ARIJ, 2007).

Pressures on water availability include population growth, growth in agricultural and industrial production, as well as general economic development. These pressures continue to put a strain on the limited water resources available, both in terms of water quality and quantity.

While a detailed assessment of the possible impact of climate change is lacking, some changes in precipitation pattern could be observed in the last decade and were attributed by the Palestinian authorities to climate change. Climate change is expected to further deteriorate water scarcity issues in the oPt.

Waste
Municipal Solid Waste (MSW) is a significant contributor of environmental and health-related problems in the occupied Palestinian territory with waste management in the oPt being still at its infancy. Between 1967 and 2004 existing waste infrastructure deteriorated and only limited development of new infrastructure took place. This has resulted in insufficient supply and limited service. There are only few sanitary landfills built to international standards, while the majority of the waste is still dumped on random dumpsites which lack proper management or monitoring. This results in a number of environmental and health problems, such as increased air pollution, continued degradation of nature and biodiversity including increased salinity and heavy metal concentrations in the soil, an aesthetic distortion of the visual environment, and an overall lower quality of life for the Palestinian population (ARIJ, 2007).

The Israeli Occupation exacerbates the existing problems of domestic and industrial waste management, for a number of reasons. First of all, sanitary landfill sites in the West Bank would typically be constructed in sites remote from densely populated areas. Such sites would be located in “Area C” and therefore require permits and licenses from the Israeli administration. Secondly, effective waste management is hindered by the geographical discontinuity of land under Palestinian control (most clearly evidenced by the segregation wall). Finally, both Israeli settlements and Israeli industries in the West Bank are reported to release solid waste into the surrounding Palestinian environment without effective controls or restrictions.

Nature and biodiversity
The occupied Palestinian territory is located in a unique position between different bio-geographic regions: the European, Asian and African continents, the Mediterranean and the Red Sea. The territories are divided into five agro-ecological zones (the Jordan Valley, the Eastern Slopes, the Central Highlands the Semi-coastal Plain, and the Coastal Plain) which are all vastly different in climate. As a result of this distinctive situation, the region has considerably high biodiversity. The natural ecosystems of the area are exceptionally important because of their unique intrinsic value, their stabilizing effect on the environment, and direct support for human activities such as agriculture, animal husbandry, forestry, traditional and pharmaceutical health products, and many others (Sabeel 2007, ARIJ 2007). As a historic centre of crop diversity and cultivation, Palestine is the birthplace of many essential crops such as wheat, barley, vines, olives, onions, and pulses (Environmental Quality Authority 2006, ARIJ 2007).

Over time, the Palestinian environment has suffered considerable degradation. Both the Palestinian population, and Israeli occupation and settlers have placed extensive pressure on the fragile ecosystem of the occupied Territories. Natural ecosystems have been, and continue to be, destroyed to make way for agricultural, industrial, or housing developments. A number of pressures therefore affect natural habitats in Palestine: unplanned urban expansion, overgrazing, over-exploitation, deforestation and unplanned forestry activities, desertification and drought, soil erosion, hunting, invasive alien species, pollution, and contamination.

The Israeli Occupation exacerbates these problems, as it limits the Palestinian Authority's ability to regulate land use, to properly monitor the status of the environment and to enforce environmental protection measures. In addition, there is also a direct impact of the Israeli occupation on natural resources, adding to the existing pressures. Direct impacts of the occupation include the building of settlements, bypass roads and military outposts, the destruction of infrastructure and seizure of agricultural land, including deforestation of forested areas.

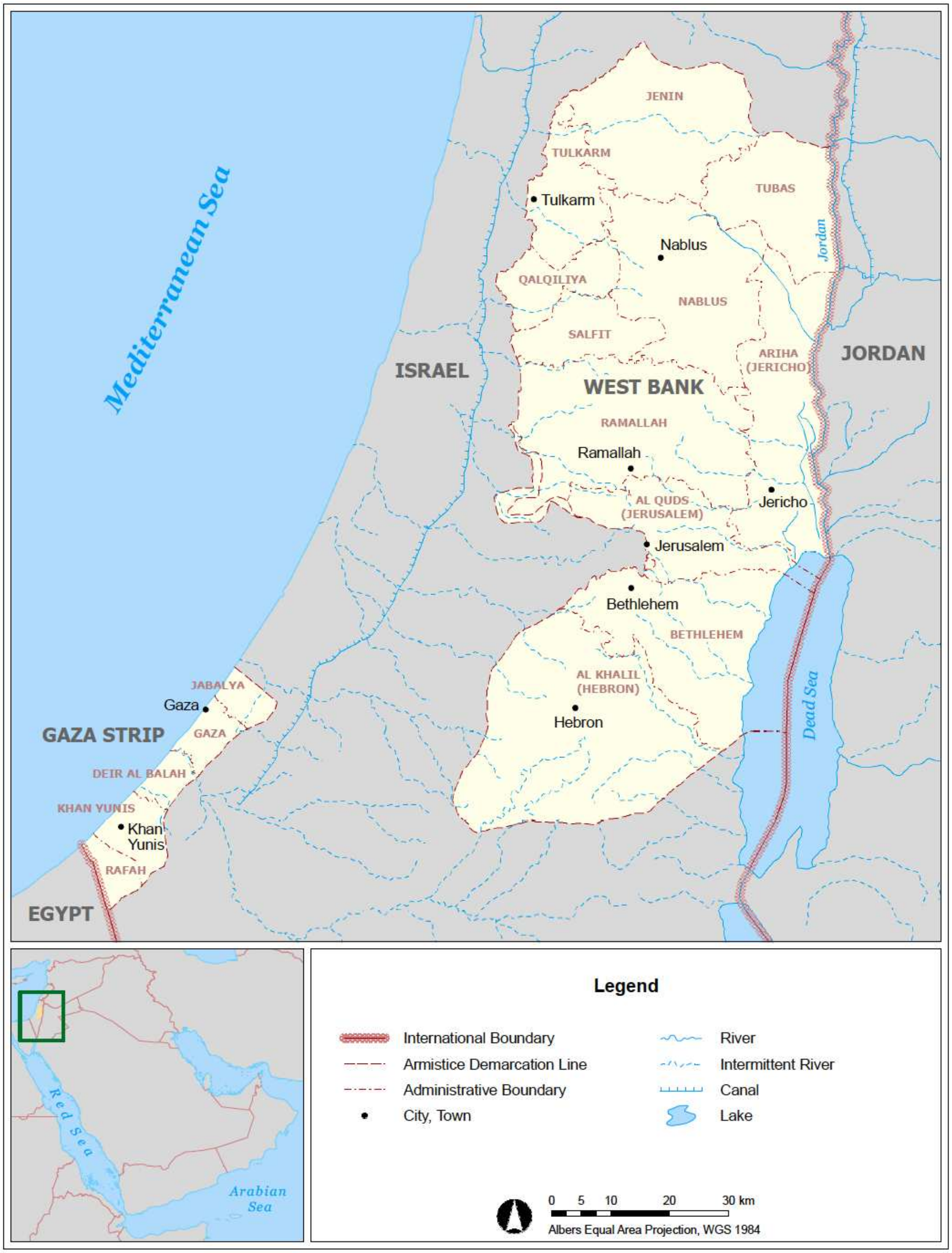
Climate Change

The oPt is, like the rest of the world, facing challenges derived from climate change. While regionalised climate change forecasts are subject to uncertainty, the IPCC predicts that, for the southern and eastern Mediterranean, warming over the 21st century will be larger than global annual mean warming – between 2.2-5.1ºC according to an optimistic emissions scenario. Annual precipitation rates are deemed likely to fall in the eastern Mediterranean, decreasing 10% by 2020 and 20% by 2050, with an increased risk of summer drought (Issam Fares Institute for Public Policy and International Affairs 2009). On the basis of predictions on the combined biophysical and socio-political vulnerabilities, water resources appear to be most susceptible to climate change, with the already existing problems related to water scarcity in both the West Bank and Gaza deteriorating as a consequence (Mimi, Mason, & Zeitoun, 2009).

The agricultural sector in the occupied Palestinian territory will be affected by climate change, due to seasonal temperature variability, higher frequency of extreme weather events (storms, torrential rain and resulting floods), higher frequency of temperature extremes that may endanger cold and heat sensitive crops, and – most importantly - decrease in water availability. Agricultural livelihoods, particularly within rural rain-fed farming communities, are always directly affected by rainfall and drought incidence. The farmers in the occupied Palestinian territory already experience difficulties when it comes to obtaining water because of the restrictions imposed by the occupation (Mimi u. a., 2009), resulting in an increase in farming production costs.

In addition, public health will also be adversely affected by the predicted shortage of water availability due to the consequences of climate change. The lack of water may result in an increase of health issues such as diarrhoea, cholera, and dehydration. The risk of parasitic disease may also increase with climate change. Increased annual and seasonal variability, elevated mean temperature, and extreme weather events are all conducive to the spreading of existing vectors and establishment of new invasive ones (Mimi et al., 2009).

While the impacts of climate change and possible responses to them have been identified as a policy matter, the mitigation of greenhouse gas emissions has been quite low on the policy agenda. However, in recent years the Palestinian Authority has expressed increased interest in climate change mitigation, notably the anticipated role for renewable energy sources and greater energy efficiency in an *independent* Palestinian energy system. Currently, renewable energy sources already account for nearly 18% of final energy consumption in the occupied Palestinian territory, mainly through Solar Water Heaters which are installed on more than 60% of the households in the occupied Palestinian territory (Yaseen, 2009). The remaining 80% of the energy consumed is based on fossil fuels, in the form of electricity and petroleum products, which are almost entirely imported from Israel. This creates a serious restrain for the oPt in developing its own energy policy, and amounts to an energy bill of about EUR 385 million per year (nearly 10% of the GDP). Hence, these conditions create a strong incentive for the oPt to increase the share of renewable and independent energy sources.



OCCUPIED PALESTINIAN TERRITORY **FAO - AQUASTAT, 2008**

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Source: United Nations Food and Agriculture Organization (FAO): http://www.fao.org/nr/water/aquastat/countries/wbgs/index.stm

3 BENEFITS OF IMPROVING AIR RELATED CONDITIONS

3.1 Introduction to air quality issues

Air pollutants may be released by either stationary sources (*point* source emissions), such as those emitted from the stack of a coal-fired power plant, or by moving sources (*line* source emissions), which include, for example, cars, buses and trucks (rail and ship transport are of less relevance in the oPt). Common pollutants include particulate matter, ammonia,9 nitrogen oxides (NO_x, including NO and NO_2 species), sulphur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), ozone (O_3), lead (Pb), mercury (Hg), nitrate and sulphate aerosols,10 and carcinogenic substances, which include several heavy metals (nickel, cobalt, chromium, arsenic), benzene, dioxins and furans, polycyclic-aromatic-hydrocarbons (PAH).

A physical impact is defined as a physiological response or reaction to an environmental stimulus, which is triggered by a pollutant emitted into the surrounding atmosphere. For this report, anthropogenic emissions are considered, i.e. emissions to the ambient air due to human related activities. Once in the environment, pollutants are transported away from the source via different dispersion routes, including air, water, soil and uptake by living organisms (plants and animals). For the case of airborne dispersion, pollutant uptake in humans may occur via three separate pathways: inhalation, ingestion and skin absorption. Emissions to water and soil environments and exchanges between these media and air will not be considered here.

Air pollution causes a wide range of human health and environmental problems. The presence of air pollutants in the air can result in pulmonary and cardiovascular illnesses and premature mortality. They can damage vegetation and buildings, including cultural heritage. Over longer distances such pollutants may be deposited as acid rain, leading to acidification and/or eutrophication of ecosystems such as forests and fresh waters, and may affect economically important resources such as fisheries.

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9 Typically, reported as total suspended particles (TSP) or suspended particulate matter (SPM). A particle or an *aerosol particle* consists of several chemical entities which are held together by inter-molecular forces and, in effect, act as a single solid or liquid unit under normal atmospheric conditions. A complete description of particulate matter requires specification of the chemical composition of its constituents and morphology (size and shape). Particles are usually identified as PMx, where x stands for the largest aerodynamic diameter (actual or equivalent) of the collective group of particles, measured in microns (a millionth of a meter).

10 Nitrate and sulfate aerosols are secondary particulates formed in the atmosphere following chemical transformations in which NOx and SO_2 species react with other substances already present in the air, such as, for example, ammonia.

3.2 Benefits from improved ambient air quality

The emissions data used to construct the baseline and policy scenarios for 2020 were taken from the EDGAR Database held by the EC Joint Research Centre. This data was used in all the 16 ENPI country-level analysis of air quality benefits under this project. The data is constructed using a modelled approach to national emissions and therefore does not rely on observed data. The use of this data therefore allows comparison between countries since a common approach has been used to estimate the emissions. Similarly, use of this data allows analysis of important components of air pollution where national air monitoring and statistical systems do not allow observations to be made. Clearly, wherever required, further analysis can exploit records of observed emissions where these are judged to be more accurate.

3.2.1 Current state of ambient air quality

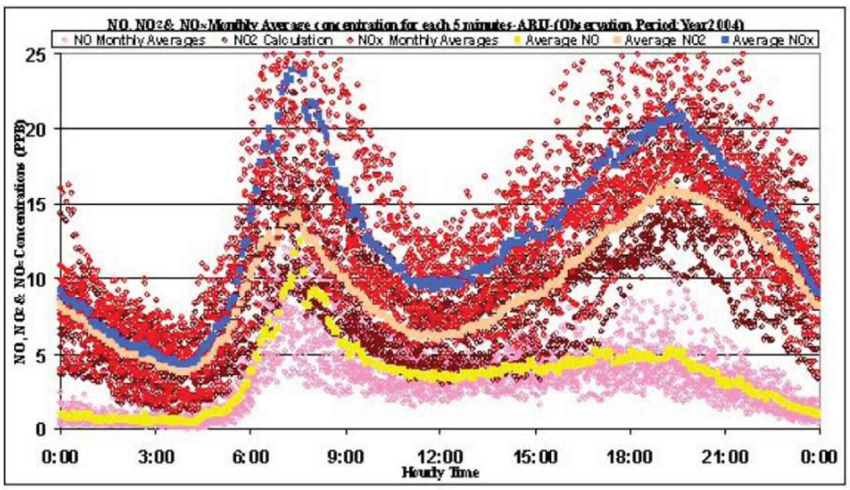
In the occupied Palestinian territory there is little data on air pollutant emissions since there is hardly any adequate measurement infrastructure. In all of the oPt, there is only one monitoring station for ambient air quality that is currently operational, which is run by the Applied Research Institute Jerusalem near Bethlehem (EQA 2010, personal communication). Assessments of air quality therefore need to rely on estimated emissions, rather than measured air quality levels. All in all, the knowledge base and data availability is poorer for air quality than for any other policy field. According to one official for the Ministry of Health, respiratory diseases are not very prevalent in the area, or at least not above the usual level in the region. However, it is recognised that the oPt is affected by substantial air pollution, especially in the main urban areas and their vicinities.

In terms of emission sources, it should be recalled that there is no power generation in the West Bank, and only one oil-fired power station in Gaza. Heavy industry is virtually absent both in the West Bank and Gaza (with the exception of industrial zones located in Israeli settlements in the West Bank, see below). One main source of air-borne emissions is the transport sector, in particular commercial vehicles, which are often old and lack modern filters. Transport is estimated to contribute about 40%-50% of the observed air pollution. Further sources of air emissions include the unmanaged burning of household waste, and dust emissions from stone quarries and stone crushing facilities (stones being one of the oPt most important export products). Moreover, agricultural activities contribute to the problem by the daily application of methyl bromide and the burning of plastic sheet waste. In Gaza, the situation is worsened by the intensity of traffic and the high age of its cars (Palestinian Environmental Strategy 2000, ARIJ 2007).

A further source of air pollution is transboundary pollution from green-line Israel and the industrial sites located in Israeli settlements in the West Bank. From green-line Israel, prevailing westerly winds carry significant amounts of pollution. For industrial installations in Israeli settlements in the West Bank, Palestinian sources point to a concentration of dirty and polluting industries, as companies attempt to escape the stricter (or more meticulously enforced) environmental regulation in green-line Israel by relocating their operations to settlements in the West Bank. However, data on transboundary air pollution from Israel is virtually absent, with only anecdotal (and often contested) evidence.

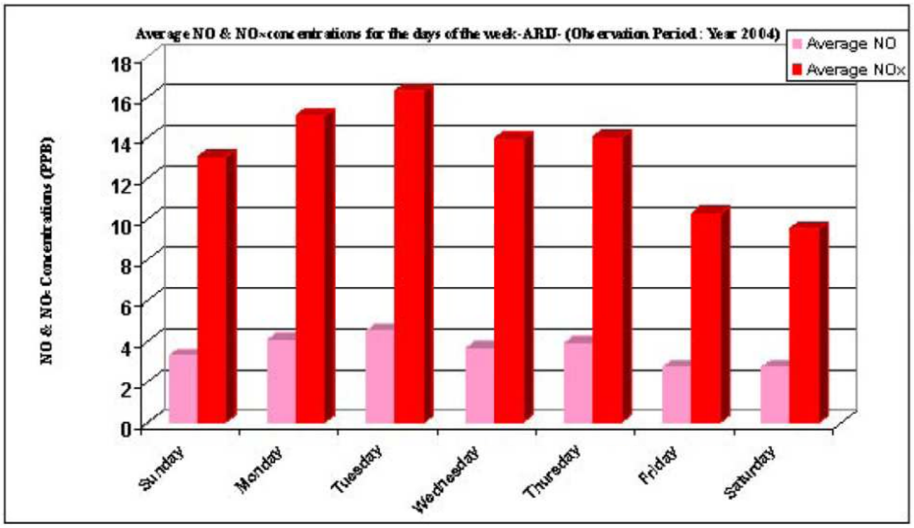
Figures 2.1 and 2.2 present average concentrations of air pollutants from a meteorological station in the northern part of Bethlehem in 2004. Figure 2.1 shows average monthly concentrations for NO, NO_2 and NO_x, during different hours of the day. The highest concentrations were recorded during 8 am and 8 pm, which can be partially attributed to transport congestion hours. Similar results were obtained for other pollutants, such as CO and SO_2 (ARIJ, 2007). Figure 2.2 presents average NO and NO_x concentrations for different days of the week. Note that although Friday and Sunday are weekend days in Bethlehem, lower concentrations of air pollution where in fact observed in Saturday and Friday, and not on Sunday. ARIJ (2007) relates this discrepancy to trans-boundary pollution which is generated in Israel (where Saturday and in some places also Friday are the weekend days).

Figure 3-1 NO, NO_2 and NO_x monthly average concentrations in 2004 (ARIJ)



Source: ARIJ, 2007

Figure 3-2 NO & NO_x average concentrations during days of the week



Source: ARIJ, 2007

3.2.2 Potential environmental improvements

The 2020 baseline level of emissions for each pollutant is simulated on the basis of the assumption that emissions increase on a linear proportionate basis to the average annual GDP growth rate, such that a 1% increase in GDP leads to a 1% increase in pollutant emission levels. The average annual GDP growth rate for the occupied Palestinian territory is assumed to be 4.9%.

There are no published targets for air quality in the occupied Palestinian territory that would apply WHO limit values or replicate the values implied by European or other legislation to the case of the oPt. Consequently, to establish targets, we adopt reductions from the 2020 baseline that have typically been required in countries adopting the EU Air Quality Framework Directive. In the case of air quality, a 50% reduction is assumed to be typical and is therefore applied. The target is therefore to reduce emissions sto 50% of their 2020 baseline. The baseline and target data are presented in Table 3-1.

Table 3-1 Air pollution emissions: Baselines and targets – oPt

Tonne	NH3	NMVOC	NOx	PPM2.5	PPMco	PPM10	SO2
Baseline 2008	23,450	133,569	65,067	21,821	13,369	35,190	102,937
Baseline 2020	36,475	207,760	101,209	33,942	20,795	54,737	160,114
50% Reduction Target	18,238	103,880	50,605	16,971	10,398	27,369	80,057

Sources for baseline emissions: European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), release version 4.1. http://edgar.jrc.ec.europe.eu, 2010"; Megapoli, contributed by TNO, 2010

The estimated health benefits of the emission reductions will be expressed in physical and monetary terms. The benefits from reduced crop damage and material soiling are included in the overall estimates of monetary benefits resulting from the reduction of emissions.

3.2.3 Qualitative assessment of the benefits of improving ambient air quality

Environmental benefits

Ecosystems: Damage to forests, lakes and streams from acidification resulting from SO_2 and NO_x has a major impact on the health of ecosystems and biodiversity in general. In some cases, acid deposition may have reached or exceeded critical loads and therefore has caused irreparable damage to ecosystems. High concentrations of lead also adversely affect domestic animals, wildlife and aquatic life, especially at the end of the food chain, as these substances accumulate at higher trophic levels (biomagnification).

Crop damage: Sulphur dioxide and nitrogen oxides, in their gas form, also contribute to crop damage through the degradation of chlorophyll. Reducing the release of these gases in the atmosphere will bring tangible benefits to agriculture, agro-forestry and fisheries industries.

Vegetation: Ozone has an impact on vegetation at concentrations not far above ambient background levels. It can cause damage to natural ecosystems and to crops. The effects of ground-level ozone on long-lived species such as trees are believed to add up over many years so that whole forests or ecosystems can be affected in the long term. For example, ozone can adversely affect ecological functions such as water movement, mineral nutrient cycling, and habitats for various animal and plant species. Ground-level ozone can kill or damage leaves so that they fall off the plants too soon or become spotted or brown.

These various impacts will be reduced as a consequence of air pollution emission reductions, as summarised in the table below.

Table 3-2 Consequence of air pollution emission reductions: Ecosystems

Environmental benefits	Description
Ecosystem condition improvements	– Reduced acidification from lower SO_2 and NO_x emissions – Reduced climate change impacts on impacts from lower SO_2 and NO_x emissions – Reduced damage to vegetation from low level ozone

Health benefits

The health consequences of exposure to air pollution are considerable and span a wide range of severity from respiratory track sensitisation and irritation, coughing and bronchitis to heart disease and lung cancer. Vulnerable groups include infants, the elderly, and those suffering from chronic respiratory conditions including asthma, bronchitis, or emphysema.

Many of air pollution's health effects, such as bronchitis, tightness in the chest, and wheezing, are acute, or short term. Other effects appear to be chronic, such as lung cancer and cardiopulmonary diseases. These health effects entail a significant economic cost including the cost to the economy (restricted activity days) and the costs to public health services. Both acute and chronic effects and can be reversed if air pollution exposures decline as a result of emission reductions. The health benefits are summarised in the table below.

Table 3-3 Consequence of air pollution emission reductions: Health

Health benefits	Description
Lower incidence of acute and chronic disease	– Reductions in SO_2 imply lower incidence of cardiovascular and respiratory disease – Reductions in PM_{10} concentrations imply lower emergency-room visits due to asthma, and also hospital admissions on the grounds of respiratory diseases – Reductions in NO_x, when combined with ozone, organic compounds, particulates and sunlight result in corresponding reductions of photochemical 'smog' that otherwise cause respiratory impairment, irritation of the eyes and mucous membrane, with asthma patients and young children.

Social benefits

The social benefits of reduced pollution to air are manifold and relate to improvements to the quality of life (e.g. through reduced negative health effects), the increased amenity value of improved landscapes and intact nature, and the reduced damage to cultural heritage such as historic building surfaces in city centres. These benefits are described in the table below:

Table 3-4 Consequence of air pollution emission reductions: Social

Social benefits	Description
Improved quality of life	– Reduced health effects – Transport emissions are a major contributor to poor urban air quality and compliance with them is one component of any comprehensive social improvement policy.
Increased amenity value of improved landscapes and nature quality	– through reduced pollution pressure
Reduced damage to cultural heritage, including among other things, historic building surfaces in city centres.	– Black smoke from traffic is a prime cause of discolouring of buildings, including public buildings of important social cultural value, such as monuments, historic buildings,

Social benefits	Description
	churches, museums. – Exposure of building materials to SO_2 deposition from acidification results in premature ageing. – Reduced blackening and erosion of surfaces (from SO_x and NO_x emissions from traffic fuel use), can improve the social appreciation and use of city centres and cultural heritage.

Informing and involving the public in environmental and health matters not only helps to build trust within communities and between communities and government, but can also improve social cohesion. More routine information requirements not only specify information provision to the public in general, but also to a range of listed interested groups. In many countries information supply to the public is poor, especially for socially excluded groups.

Economic benefits

Economic benefits are associated with the avoided health impacts – lower cost for the public health sector, but also higher productivity, as fewer working days are lost. Other benefits accrue to the tourist sector. Both urban and natural areas become more attractive for recreation, sport and leisure with reduced air pollution. These economic benefits are summarized in the table below.

Table 3-5 Consequence of air pollution emission reductions: Economic

Economic benefits	Description
Improved opportunities for outdoor uses in urban areas (pedestrian shopping malls, street cafes etc.)	– Increase in tourism and associated revenues in urban areas
Increased visits to improved landscapes and natural areas	- Increase in tourism and associated expenditures in natural areas.
Lower material cleaning costs	- Reduced cost for cleaning or restoring building surfaces soiled by particulates or damaged by acid rain
Crop damage reductions	– Reduced crop damage from lower SO_2 and NO_x emissions – Reduced crop damage from low level ozone

3.2.4 Quantitative assessment of the benefits of improving ambient air quality

The physical and monetary estimates of the benefits of air quality improvements that are presented in this section are derived from an integrated atmospheric dispersion and exposure assessment model co-ordinated by the central project team. The model – an integrated software tool called EcoSense - assesses impacts resulting from the exposure to airborne pollutants, namely impacts on human health, crops, building materials and ecosystems. In the current exercise, it includes the emissions of 'classical' pollutants SO_2, NO_x, primary particulates, (fine and coarse), NMVOC and NH_3.

The model and overall method are documented more fully in the Benefit Assessment Manual.

The air quality model produces an output in terms of Euro per tonne of pollutant. Since we were unable to apply the model directly in the occupied Palestinian territory with the resources available, these unit values (Euro per tonne of pollutant) for individual pollutants were transferred from Tunisia which were judged to have broadly similar conditions (population density, geography etc). Clearly this transfer introduces an additional uncertainty in the measurement of total benefits.

The unit value per tonne of pollutant was then multiplied by the emissions reductions projected for each pollutant, as identified above, to generate estimates of total benefits per pollutant. The benefits for all pollutants were then summed to generate estimates of total air quality benefits for 2020, assuming a 50% reduction from projected baseline emissions. The aggregate benefits were than apportioned to the different impact categories, according to the outputs of the air quality model. Typical percentage splits were: mortality (70%); morbidity (20%); crops (6%) and materials (4%).

As a sensitivity exercise, we also provide indicative estimates of potential transboundary effects. These are derived again through a transfer procedure, that identifies trans-boundary effects for each pollutant as percentages of total damages from existing modelling outputs in countries that are judged to have similar relevant characteristics e.g. with respect to the wind directions and strengths, the size of the country, the existence of a large number of neighbour countries or a long coastline, and the density of the potentially affected population. The method is described more fully in the Benefit Assessment Manual.

Health benefits

The benefits of reduced air pollution can be quantified for the following pollutants: Ammonia (NH_3), particulate matter (coarse and fine) (PM), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and non-methane volatile organic compounds (NMVOCs).

The mortality and morbidity benefits of the pollution emission reductions assumed above for the oPt are shown in Table 2.6 below for 2020 – the year in which it is assumed the 50% reduction from 2020 levels is achieved. Morbidity impacts are of a disparate nature and so cannot be expressed as a common unit. However, for illustration, the morbidity impacts are presented as equivalent number of cases of chronic bronchitis avoided (Table 2.6).

Table 3.6 Physical premature mortality and morbidity impacts avoided in year 2020

Total	
Deaths	*Cases*
220	440

Economic benefits

In the case of materials, the impact quantified is the premature ageing of building materials as a consequence of exposure to SO_2 deposition. Thus, the exposed surface area to SO_2 would age at a slower rate if emission were reduced. The economic benefits are therefore estimated by multiplying the changes in aggregate damage to the surface areas by the cost of cleaning these surface areas.

Crop damage is measured primarily by the change in yield that results from the change in pollutant concentrations in the air. Thus, with knowledge of the geographical distribution of crop plantations within a country, the acreage of a given crop affected by a change in pollutant concentration can be estimated and the percentage yield change can be derived. The modelling then multiplies this aggregate yield change by the market price of the crops. As no sufficiently detailed data was available to make this estimate, the calculation resorts to average benefit values, ignoring the spatial distribution of crops and pollutant concentrations.

3.2.5 Monetary assessment of the benefits of improving ambient air quality

The monetary values of the benefits from reduced air pollution - as assumed above - are presented in summary form in Table 3.. Values presented are in million Euros (2008 prices), and relate to the year 2020, to which the assumed target of a 50% emission reduction applies. Underlying unit values, unadjusted for PPP, are listed in the Benefit Assessment Manual.

The benefits are valued at EUR 193,700 or NIS 508,800 per avoided fatality and EUR 40,000 or NIS 105,000 per avoided case of chronic bronchitis-equivalent. All figures are in 2008 purchasing power parity (PPP) adjusted Euros and 2008 NIS. Table 2.7 shows that the total domestic benefits to the oPt are equal to EUR 68 million each year, equivalent to 0.5% of annual GDP. These domestic benefits are understood as benefits which accrue to the oPt as a result of its own emission reductions.

Table 3.7 Annual Compliance Benefits – OPT 2020

	EUR PPP (millions)	NIS (millions)	% of GDP
Mortality	48	126	0.3
Morbidity	14	37	0.1
Crop	4	10	0.03
Material	2	5	0.01
Total Domestic	68	178	0.5

In an additional sensitivity analysis, initial estimates were conducted of the possible trans-boundary benefits – i.e. outside the occupied Palestinian territory – that may result from the air pollution emission reductions in the occupied Palestinian territory. These results can principally draw attention to the fact that these trans-boundary effects exist and may be important in assessments of regional air quality strategies.

4 BENEFITS OF IMPROVING WATER RELATED CONDITIONS

4.1 Introduction to water quality and water scarcity issues

Water is the most prevalent issue on the environmental agenda. In terms of water sources, there is hardly any use of surface water, which tends to be seasonal and in short supply. Instead, both Gaza and the West Bank rely on groundwater for more than 95% of their water needs. The issue of water is strongly linked to the specific circumstances of the Israeli occupation, both in terms of access to the available water resources, and by limiting the Palestinian National Authority's capacities to effectively manage and improve the situation (e.g. drilling of wells, construction of sewage and wastewater treatment infrastructure). Access to water is among the most contentious points in the negotiations between Israel and the occupied Palestinian territory. While the Oslo agreement specified the Palestinians' and Israelis' respective rights to the groundwater resources under the West Bank, this share is not reflected in the actual distribution of the abstracted water. The drilling of wells and the abstraction of water is controlled by the Israeli authorities for all of the West Bank and Gaza, irrespective of the Oslo status (Areas A, B or C).

Consequently, in the West Bank, authorities take issue not so much with the overall scarcity of water, but rather its distribution between Israelis and Palestinians. Although the evidence on water abstractions is contested and reliable data is hard to come by, the World Bank (2009, p. 11) estimates that Palestinians in the West Bank have estimated between 113 and 138 MCM from the three aquifers that are shared between the West Bank and Israel, and which together form the "Mountain Aquifer". Palestinian abstractions have actually declined between 1999 and 2007: there is anecdotal evidence of dried-up wells and falling water tables due to overabstraction from the aquifer. Palestinian abstractions correspond to 17-20% of the "estimated potential" of the aquifers, as it was defined in the Oslo Agreement. By contrast, according to the World Bank estimates, Israel abstracted some 871 MCM in 1999, well in excess of the 483 MCM allocated to Israel in the Oslo agreement. Of this, according to unofficial figures quoted by the World Bank, some 44 MCM are produced from 40 Israeli-controlled wells in the West Bank, and supplied to Israeli settlements. This brings total abstractions to more than 1,000 MCM in 1999, considerably above the "estimated potential" defined in the Oslo Agreement, and also exceeding all other estimates of the recharge rate. The uneven distribution of the abstracted groundwater means that per capita consumption levels differ strongly between the occupied Palestinian territory and Israel. By contrast, scarcity and overuse of groundwater resources are already a very critical issue in Gaza, where continuous overuse of the coastal aquifer has resulted in the intrusion of sea water into the aquifer, and consequently a deterioration of water quality.

Both in the West Bank and Gaza, the current scarcity situation is expected to deteriorate due to climate change, which is expected to decrease water availability, but also due to population growth and economic development as drivers of water demand. While a detailed assessment of the possible impact of climate change is lacking, some changes in precipitation pattern could be observed in the last decade. There tends to be less rainfall, and rainfall is delayed by a month compared to the long-term average. The Palestinian authorities attribute these changes to climate change.

The (financial) management of the water services sector leaves a lot of room for improvement. Full cost recovery of water service providers, i.e. including financial as well as environmental and resource costs, has not been accomplished. Even operation and maintenance costs are rarely recovered from the water fees. This is partly due to the high percentage of unaccounted for water (between 25-45% of the total water supply), inefficient fee collection practices (average fee collection rates < 50% with Government debt exceeding 580 million Shekels) and contradictory taxing and pricing procedures due to water service providers' non-standardized methods of calculating unit costs and prices (Palestinian Water Authority, 2009).

Surface water does not play a major role for Palestinian water supply. With the Jordan River, there is only one permanent river that – theoretically – delivers a sufficient quantity of water for abstraction. However, access to this river (and its water) is prohibited for Palestinians. And, more importantly, massive over-abstraction and pollution in upstream areas means that there is essentially no water left in the river to use for irrigation or other purposes, also leading to rapidly falling water levels of the Dead Sea (ARIJ, 2007). Rainwater harvesting and rain-fed agriculture play a small role for water supply, as rainfall tends to be limited (500 – 600 mm per year on average) and concentrated in the months December - March.

The fact that surface water bodies are absent, or only exist seasonally, also means that recreational uses of water are practically non-existent. The most important water body in this respect is the Dead Sea, which is both an outstanding natural phenomenon and an important tourist destination. However, the touristic exploitation of the Dead Sea is almost exclusively in the hands of Israeli businesses: the resorts on the Dead Sea shore are run by Israelis only; only a small number of Palestinian tour operators have a marginal share in the touristic exploitation of the Dead Sea.

The current wastewater treatment plants in the West Bank are inadequate to serve the amount of wastewater generated. According to PCBS surveys, about 31% of the West Bank population are connected to a sewerage network and 69% still rely on septic tanks, while in Gaza about 60% of households are connected to a sewerage network (PCBS 2006). However, connection is significantly less in rural areas; in addition, some major cities (e.g. Jericho) remain without centralised wastewater collection. In areas that are not connected to the network, wastewater is discharged into percolating pits. Cesspits are emptied by vacuum tankers, which usually dump their contents in open areas, valleys, sewage networks and/or dump sites (Palestinian Hydrology Group: Palestine Water for Life Campaign 2006). Even where households are connected, leaking of collected wastewater from sewage systems and cesspits is problematic.

However, there is at this stage no proper wastewater treatment in the West Bank; on the whole, only 5% of all wastewater is treated adequately, the rest is discharged into the environment without treatment. As the West Bank is the area of recharge for its aquifer system, the direct discharge of untreated or partially treated wastewater into open areas endangers the groundwater quality (ARIJ, 2007). In Gaza, three wastewater treatment plants exist. However, these operate well above their capacity and are in need of upgrade and maintenance, and therefore do not function effectively.

The lack of effective wastewater treatment leads to deteriorating nature, biodiversity and groundwater quality while it endangers public health (ARIJ, 2007). The improper treatment of sewage and wastewater remains the single most detrimental factor behind the spread of infectious and parasitic diseases in many Palestinian communities. The flooding of collection systems (cesspits, open channels, and pipelines) can result in spillage of raw sewage in residential areas, encouraging the spread of pathogens and insect breeding. This causes public health risks through direct exposure, as well as the reuse of untreated wastewater on irrigated lands. The pollution of the water aquifer in Gaza has the potential to significantly damage the drinking water for almost 1.5 million Palestinians. The most common waterborne diseases found include Amoebas, Hepatitis A, and blue baby syndrome. Other diseases revealed through epidemiological studies are throat infection, diarrhoea, rhinitis, skin diseases, asthma, dysentery, jaundice and cancer. Other diseases, such as leishmaniasis, are spread by the increase of insects that breed in standing pools of untreated wastewater (ARIJ 2007).

This section will cover the following aspects of water quality:

- Man-made infrastructures:
  - Connection to safe drinking water, sanitation and hygiene
  - Level of waste water treatment
- Natural assets
  - Water resource use

4.2 Benefits from improved drinking water, sanitation and hygiene

4.2.1 Introduction

This section assesses the benefits of improvements in three household water, sanitation and hygiene parameters:

- connection to a reliable and safe piped drinking water supply on premises;
- connection to a sewage network; and
- improved domestic and personal hygiene practices whenever such practices are inadequate for health protection.

Benefits of improved wastewater treatment are assessed in another section.

The section specifies a set of targets for the three parameters to be achieved by 2020. Improvements resulting from reaching the targets are estimated at the national level, benefits of these improvements are discussed qualitatively, with some benefits also assessed in quantitative terms. The quantitative assessment of the three water, sanitation and hygiene parameters is undertaken jointly as many households will benefit from improvement in more than one parameter.

Piped water supply to premises (yard/dwelling) and connection to a sewage network are generally the best opportunity to provide households with reliable and safe drinking water and to ensure safe and hygienic removal of human excreta and other wastewater pollutants from the household and community environment.

Piped water supply from a central water intake and distribution outlet allows for treatment of water and monitoring of water quality. If source water is generally of good quality and the piped distribution networks are well-functioning, such a water supply system can provide safe drinking water with minimal risk of disease.

Connection to a sewage network provides the added benefit of minimizing pollution of water and land resources by centralising the treatment of wastewater.

Good hygiene practices are of utmost importance for disease prevention. The single most important hygiene practice is hand washing with soap at critical junctures (after defecation/going to toilet or cleaning a child faeces, before cooking and eating, and before feeding a child), found in many countries to reduce incidence of diarrhoea by as much as 45 percent (Curtis and Cairncross 2003; Fewtrell et al 2005).

4.2.2 Current status of drinking water quality, sanitation and hygiene

Inadequate maintenance of municipal water systems, particularly in rural areas, has led to the deterioration of water services. Some parts of the Palestinian population therefore rely on tankers to deliver water. This water does not necessarily meet the required water quality standards, despite increasing water prices. The affected households spend around 1/3 of their total family income on water, while the internationally accepted levels specify that "affordable water" should cost a maximum of 5% of the average income (ARIJ, 2006b).

By 2005, 90% of the West Bank population (64% of communities) were connected to water networks. In Gaza all communities and 98% of the population were connected to water network (PWA 2005). Around 170 villages in the West Bank still lack access to a piped water system (ARIJ, 2006b). About 13% of the population use other improved drinking-water sources, while nearly 10% of the population rely on unimproved drinking-water sources (Table 4-1, WHO, UNICEF, 2010 a,b). Where piped water systems exist, their lack of maintenance has led to high leakage rates and frequent supply interruptions, ranging e.g. between 35-50% in the Gaza Strip, which leads to a further deterioration of water quality (ARIJ, 2006b).

Water consumption in the oPt is quite low by international standards. Palestinians in the West Bank who are connected to piped water on premises use an average of 75 litres per capita per day (l/c/d), whereas West Bank residents without connection to drinking water on premises use 40l/c/d. In the Gaza Strip, water consumption averages 105 l/c/d (ARIJ, 2006b). The WHO (2003) compared the daily water access per capita with the consequent level of health concern. The basic access of around 20l/c/d will suffice to satisfy the most basic consumption needs, but poses a health risk, as it does not allow for adequate hygiene practices. Intermediate access of 50 l/c/d assures all basic personal and food hygiene in addition to satisfying consumptive needs, lowering the associated health risks. However, all hygienic and consumptive needs are only satisfied by an optimal access of 100 l/c/d, leading to a very low level of health concern. Comparing these values with the levels of water consumption in the oPt, it becomes apparent that the available water supply is not adequate to properly address public health concerns.

Roughly 65% of the population have flush/pour flush toilets connected to a sewage network system while 24% have access to other improved toilet facilities and the remaining 11% rely on unimproved sanitation (Table 4-1, WHO, UNICEF, 2010a,b).

Population coverage of piped water supply is substantially higher in urban than in rural areas. However, no data could be retrieved for urban versus rural sewage connection.

Table 4-1 Household access to drinking water and sanitation facilities, % of population 2008

Drinking water	Urban	Rural	Total
Piped water on premises	84%	64%	78%
Other improved water sources	7%	27%	13%
Unimproved water sources	9%	9%	9%
Sanitation			
Toilet connected to sewage network			65%
Other improved sanitation			24%
Unimproved sanitation*	9%	16%	11%
of which: Open defecation	0%	0%	0%

Source: Produced from WHO/UNICEF (2010a,b).
Note: * including toilet facilities shared by households.

4.2.3 Potential environmental improvements

Targets to be reached by 2020

Targets for which benefits are assessed in this study are:

Drinking water:

- Achieving 100% population connection (except in isolated rural areas) to reliable and safe piped water supply at household premises.
- Ensuring that the population currently having piped water supply continuously receives reliable and safe water at household premises.
- Providing plentiful and equally safe drinking water from other improved water sources in isolated rural areas.

Sewage connection:

- Achieving 100% population connection (except in isolated rural areas) to a sewage network system.

- Upgrading to flush toilet (with sewage connection) for households with dry toilet or no toilet).
- Providing improved sanitation to households currently without such facilities in isolated rural areas.

Hygiene:

- Improving hygiene practices especially ensuring good hand-washing with soap at critical junctures wherever such practices are currently inadequate for protection of health.

While piped water supply and connection to a sewage network have many advantages, these systems are, however, not necessarily problem-free. Piped water can get contaminated in the distribution network before reaching the household, and sewage may seep into the environment from leaky and broken network pipes. Thus, in order to achieve the targets, existing piped water and sewage networks may need rehabilitation to minimize water supply contamination and cross-contamination from sewage networks. Proper functioning also requires continuous appropriate pressure in existing and new piped water networks for a reliable supply of water.

Information on the status of hygiene practices is generally not available in most countries unless detailed studies/surveys have been undertaken. What is clear, however, is that substantial improvements in hygiene practices can be achieved in most countries in the world. As the status of hygiene practices is not well known in West Bank and Gaza, the assessment in this study provides a benefit range for achieving the targets that, at the lower end, reflect the assumption that hygiene practices are generally adequate for protection of health and at the higher end reflect the assumption that practices can be substantially improved. In reality, benefits may be expected to be somewhere in between these two.

Baseline to 2020

To estimate the number of beneficiaries and benefits of achieving the targets, the targets are compared to the percentage of the population currently equipped with piped water supply on premises, connection to a sewage network system, and good hygiene practices adequate for health protection. As hygiene practices are not well known, a range of 0-100 percent is applied. Other baseline data are presented in Table 4-2. These data represent projections or a business-as-usual scenario as if no water, sanitation and hygiene interventions were undertaken to reach the targets.

Baseline assumptions:

- Birth rates are projected to decline by 10 percent.
- The diarrheal child mortality rate and diarrheal incidence rates are assumed to be constant.
- The child mortality rate from other infectious diseases is projected to decline by 1.5 percent per year.
- Average household size is assumed constant over the period to 2020.

Table 4-2 Baseline assumptions for drinking water, sanitation and hygiene, 2020

	2008 (actual or estimated)	2020 (projected or business-as-usual)
Population (million)	3.94	5.45
Birth rate (births per 1000 population)	35.5	32.0
Mortality rate from diarrhoea among children < 5 years (deaths per 1000 live births)	1.4	1.4
Mortality rate from other infectious diseases among children < 5years (deaths per 1000 live births)	6.5	5.4
Diarrhoea (cases/year, children < 5 years)	2.5	2.5
Diarrhoea (cases/year, population >= 5 years)	0.5	0.5
Household size	6.3	6.3

Sources:
Data for 2008 and population projections are from World Bank (2010) and WHO (2010).
Household size is from the Palestinian MICS 2006; http://www.unicef.org/statistics/index_24302.html
Cases of diarrhoea are estimates from the Palestinian MICS 2006 and comparable countries in the region.

Improvements achieved by reaching the targets

The improvements from reaching the targets by 2020 are the difference between the specified targets and the baseline assumptions.

Improvements include:
An additional 1.2 million people (0.2 million households) would have reliable and safe piped water to premises, and an additional 1.9 million people (0.3 million households) would have connection to a sewage network system (Table 4-3).

- As some rural communities may be too isolated to have these services provided, an unspecified but relatively small number of these people would be provided plentiful and equally good quality water from other improved water sources and improved sanitation facilities if currently without such facilities.
- Potentially a large share of the population that already has piped water to premises would benefit from improvements in reliability and quality of water (so as to have safe water on premises) by improved central water treatment and rehabilitation and upgrading of existing water distribution networks.
- Depending on current hygiene practices, potential beneficiaries of hygiene promotion range from 0 – 5.5 million people (0 – 0.9 million households).

Table 4-3 Number of beneficiaries of reaching the targets, 2020

	Number of people (million)	Number of households (million)
Reliable and safe piped water supply to premises	1.20	0.19
Improvement in reliability and quality of water among those currently with piped water supply	0-4.25	0-0.68
Connection to sewage network	1.9	0.3
Improved hygiene practices	0-5.45	0-0.87

Source: Estimates by the authors.

4.2.4 Qualitative assessment of the benefits of reaching the targets

Provision of reliable and safe piped drinking water, connection to a sewage network system (and and flush toilet for those with dry toilet or no toilet), and practice of good hygiene (personal, household and community) have many benefits including health, environmental, economic and social benefits. A generic overview of these benefits is provided in Table 4-4. Some of these benefits (environmental, recreational, improved water resources) are discussed in the sections on Wastewater Treatment, Surface Water Quality, and Water Scarcity).

Table 4-4 Benefits of improved potable water supply, sanitation and hygiene practices

	Good quality piped water supply	**Connection to a sewage network system (and flush toilet for those with dry toilet or no toilet)**
Health benefits	• Good quality piped water supply, hygienic sanitation (flush toilets connected to sewage network) and good hygiene practices reduce the presence and transmission of pathogens, thus reduce the incidence of diarrhoea and other diseases (Fewtrell et al, 2005). • Reduced incidence of diarrhoea in early childhood contributes to improved nutritional status among children (World Bank, 2008). • Good hygiene practices (especially regular hand washing with soap) also reduce transmission of respiratory infections (Rabie and Curtis, 2006; Luby et al, 2005). • Reduced chemical, heavy metal, and other toxic substances contamination of drinking water reduce the incidence of associated diseases and health disorders.	
Environmental benefits	• Piped water connection and improved piped water quality do not lead to direct environmental benefits. • However, some benefits to habitats and water resources may accrue if water utilities press for protection or restoration of water quality of raw water abstraction sources.	• Sewage collection provides opportunity for proper treatment of wastewater which helps improve environmental quality including cleaner communities, cleaner urban and rural waterways (e.g., canals), cleaner rivers, lakes and coastal waters, and reduced pollution of land resources (see sections on Wastewater Treatment

Table 4-4 Benefits of improved potable water supply, sanitation and hygiene practices		
	Good quality piped water supply	**Connection to a sewage network system (and flush toilet for those with dry toilet or no toilet)**
		and Surface Water Quality).
Economic benefits	• Piped water connection with reliable and continuous good quality water reduces/ eliminates the need for: o household water storage tanks o spending time and money on household point-of-use treatment/ disinfection of water prior to drinking or on purchase of bottled water. • Good quality piped drinking water also: o reduces public and private health care expenditure o improves labour productivity and reduces work absenteeism. • Access to good quality water can also provide cost savings to industries and make them more competitive, especially those relating to the food and beverage processing. • Rehabilitation of existing piped water distribution networks (to improve water quality) reduces water losses and thus costs of providing potable water.	• The environmental benefits (see above) of sewage collection and proper treatment of wastewater can provide substantial recreational, tourism, and fishery benefits. • Good treatment of wastewater can also: o allow for wastewater reuse in agriculture o provide substantial cost savings in mobilizing and treating potable water, especially important in water scarce countries (see section on Water Scarcity).
Social benefits	• Piped water connection with reliable and continuous good quality water supply provides increased convenience from having potable water available at premises. • Access to good quality piped water also improves the public's perceptions of utilities and the state providing good quality services.	• Sewage connection (and hygienic toilet on premises for those currently without it) o increases household convenience (no needs for emptying and maintaining sewage pits/septic tanks; reduced access time to toilet facility or place of defecation), o and reduces odours and nuisance from preventing direct sewage discharge into the local environment.

Source: Authors' own compilation.

4.2.5 Quantitative assessment of the benefits of improving drinking water quality, sanitation and hygiene

As many of the benefits of reliable and safe piped water supply and connection to a sewage network are difficult to quantify, the assessment in this study is limited to:

- reduced incidence of diarrheal disease,
- reduced mortality from diarrheal disease, and
- reduced mortality from infectious diseases associated with improved nutritional status in young children from reduced incidence of diarrhoea.

Table 4-5 presents the expected reduction in annual incidence of diarrheal disease and diarrheal mortality from reaching the targets, distinguished by population groups in relation to their current status of water supply, sanitation status (i.e. sewage connection), and hygiene practices. Among young children, these diarrheal disease reductions are expected to somewhat improve their nutritional status and thus reduce the risk of fatality from infectious diseases.11

Some clarification of these expected disease and mortality reductions are warranted. While groups 1-2 currently have piped drinking water supply, some households are likely to have sub-optimal water quality when connected to old, leaky networks and/or networks with fluctuating pressure and irregular continuity of supply, as water will be susceptible to contamination along the water distribution network even if water is well treated at central treatment plants. A 15% reduction in diarrheal disease and mortality is therefore expected on average for these population groups from improved reliability and quality of piped water. For population groups 3-4, which currently do not have piped water supply, a 25% reduction in disease and mortality is expected from receiving reliable and safe piped water supply to premises and in greater quantities than from their current water sources. Connection to sewage network (and flush toilets for those currently without such toilets) for groups 2 and 4 reduces the risk of pathogen transmission and is expected to reduce disease and mortality by an incremental 20%. If there also is substantial scope for improvement in hygiene practices among any of these population groups, disease and mortality reduction is expected to be an additional 30%.12

Based on the current distribution of population water and sanitation coverage, reaching the targets is estimated to reduce diarrheal disease and diarrheal mortality nationwide by 27% if the entire population has good hygiene practices adequate for health protection, and 59% if hygiene practices can generally be substantially improved. In actuality, disease and mortality reduction likely falls somewhere in between these two values, depending on current hygiene practices.

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11 See World Bank (2008) for a discussion and quantitative assessment of the nutritional impacts and associated health outcomes of repeated diarrheal infections in young children.

12 The expected diarrheal disease and mortality reductions are based on adaptations of findings reported in Arnold and Colford (2007), Clasen et al (2007), Fewtrell et al (2005), and Curtis and Cairncross (2003).

Table 4-5 Expected diarrheal disease and diarrheal mortality reduction from reaching the targets by population group

				Expected average reduction in diarrheal disease and mortality	
Groups	***Current water supply and sanitation coverage***	***Population distribution 2008***	***Water and sanitation improvement***	***Already good hygiene***	***Substantial scope for hygiene improvement***
1	Piped water supply and sewage connection	63%	Improvement in reliability and quality of piped water (so as to ensure plentiful and safe water supply) for those of this population currently having water reliability and quality problems	15%	45%
2	Piped water supply but no sewage connection	15%	a) Improvement in reliability and quality of piped water (so as to ensure plentiful and safe water supply) for those of this population currently having water reliability and quality problems. b) Sewage connection (and flush toilet for those with dry toilet or no toilet) for all of this population.	35%	65%
3	Not piped water supply but sewage connection	2%	Reliable and safe piped water supply to premises for all of this population	25%	55%
4	Not piped water supply and no sewage connection	20%	Reliable and safe piped water supply and sewage connection (and flush toilet for those with dry toilet or no toilet) for all of this population	45%	75%
	National total	**100%**		**27%**	**59%**

Source: Authors. Population distribution estimated from WHO/UNICEF (2010a,b) and the Palestinian MICS 2006 survey, http://www.unicef.org/statistics/index_24302.html

4.2.6 Monetary assessment of the benefits of improving drinking water quality, sanitation and hygiene

Based on the distribution outlined in Table 4-5, the annual benefits in 2020 of achieving the targets amounts to 1.2-2.6 million avoided cases of diarrhoea and 88-193 avoided deaths (Table 4-6). These benefits are valued at EUR 45-99 million or NIS 118-260 million, equivalent to about 0.32-0.70 percent of GDP in 2020. The benefits are valued at EUR 193,700 or NIS 508,800 per avoided fatality and EUR 23 or NIS 62 per avoided case of diarrhoea. All figures are in 2008 purchasing power parity (PPP) adjusted Euros and 2008 NIS.

Table 4-6 Estimated annual benefits in 2020 of meeting the water, sanitation and hygiene targets

	Annual cases avoided			
	Low	High		
Diarrhea	1,189,077	2,622,643		
Deaths	88	193		
	Annual monetized benefits			
	Million Euros (PPP)		Million NIS	
	Low	High	Low	High
Morbidity	28	61	73	162
Mortality	17	37	45	98
Total	45	99	118	260
Total (% of GDP)			0.32%	0.70%

Source: Estimates by the authors.

Note: "Low" represents cases avoided and costs if the population already has good hygiene practices adequate for health protection. "High" represents cases avoided and costs if population hygiene practices can generally be substantially improved.

4.3 Benefits from improving the level of waste water treatment

4.3.1 Current state of waste water treatment

A key problem related to water is the pollution from wastewater and associated public health impacts due to polluted and standing waters (Palestinian Water Authority, 2009).

In 2005, around 66 MCM of wastewater were generated in the oPt, of which 36 MCM were produced in the West Bank and 30 in the Gaza Strip. About 35.5 MCM of wastewater, or 55.3% of the total wastewater volume produced in 2005, were collected by the sewage network (ARIJ, 2007). In urban areas, the majority of households are connected to wastewater collection, with connection rates of up to 90%. However, connection is significantly less in rural areas; in addition, some major cities (e.g. Jericho) remain without centralised wastewater collection. In the border regions of the West Bank, some Palestinian villages are connected to Israeli wastewater collection and treatment systems. In areas that are not connected to the network, wastewater is discharged into percolating cesspits and open channels (Palestinian Hydrology Group: Palestine Water for Life Campaign 2006). 29.5 MCM of the wastewater was collected in cesspits, while 0.4 MCM were discharged into open channels (ARIJ, 2007, p. 118). Around 43% of the total population of the oPt are served by conventional gravity sewage networks (PCBS, 2006). 13

13 In the West Bank, 56 communities were connected to the sewage network, while 513 communities dispose their sewage in cesspits. In the Gaza Strip, 19 communities are connected to the sewage network and 11 use cesspits. In total, around 43% of the OPT population (PCBS, 2006)

The wastewater treatment infrastructure in the West Bank is clearly inadequate to handle the amount of wastewater collected. The existing waste water treatment plants at Hebron, Jenin, Ramallah and Tulkarem perform at efficiency levels of 10-30%, which results in poor effluent quality (World Bank, 2009: 20). It is estimated that 33.5 MCM/year of wastewater are discharged untreated into the environment.14 Some of this wastewater flows into Israel, which in some instances is treated in Israeli wastewater treatment plants and subsequently used for irrigation (ARIJ, 2007; Al-Sa'ed, 2009).

Three central wastewater treatment plants are located in the Gaza Strip, more specifically in Beit Lahiya, Gaza and Rafah. While their joint capacity adds up to 25 MCM/year, they only function at moderate efficiency rates (40-60%), operate above their capacity and are in need of upgrade and maintenance. The remaining 4.9 MCM/year of untreated wastewater and the (partially) treated wastewater is discharged into the environment, e.g. Wadi Gaza or the Mediterranean (ARIJ, 2007, p. 122). Around 10 MCM of treated wastewater is reused in the Gaza Strip (FAO, 2009)

Table 4-7 Waste water discharge and treatment (2006)

	Total	**Primary treatment (Mechanical treatment plants)**			**Secondary treatment**	**Tertiary treatment (if any)**
		Sea outfall*	Inland water outfall*	Total		
Total waste water discharged (m3/day)	180,821					
# inhabitants connected to WWT plants**	982,168	n/a	n/a	833,442	148,729*	n/a
Total population***	3,937,309					
% connected over population	24.9%	n/a	n/a	21.2%	3.8%	n/a
Waste water treated (m3/day)	75,471	n/a	n/a	68,567	6,904	n/a
% treated over total waste water discharged	41.7%	n/a	n/a	38%	3.8%	n/a
# WWT plants	4	n/a	n/a	3	1	n/a
WWT plants total capacity (m3/day)	74,317	n/a	n/a	68,567	5,750	n/a

** Assumption that the percentage of wastewater treated coincides with the percentage of population served.*
Source: ARIJ, 2007

Table 4-8 provides an overview of the currently operating wastewater treatment plants in the oPt.

14 According to Palestinian sources, wastewater from Israeli settlements account for another 30 MCM/year.

Table 4-8 Wastewater treatment plants in oPt

Name	Area	Population served	Capacity (m^3/day)	Construction date	Type of treatment
Al-Bireh	West Bank	148,729*	5,750	1998	single stage activated sludge
Beit Lahiya	Gaza Strip	236,298	12,000	1976	Aerated and facultative ponds
Gaza	Gaza Strip	446,416	51,000	1978	Aerated lagoons
Rafah	Gaza Strip	150,725	5,567	1987	Extended aeration

** Assumption that the percentage of wastewater treated coincides with the percentage of population served.*
Sources: ARIJ, 2007; Dahlem, 2011

Even where households are connected, leakage of collected wastewater from sewage systems and cesspits is problematic. Cesspits in the oPt are typically constructed without a concrete liner, thus facilitating seepage into the ground and endangering groundwater quality. Cesspits are emptied by vacuum tankers owned by municipalities or private businesses. Considering the absence of adequate treatment facilities, these services usually release the sewage into nearby wadis or disused land, causing considerable environmental damage (ARIJ, 2007).

A survey by ARIJ (2007) identified 363 main disposal sites in the West Bank and 20 in the Gaza Strip, at which vacuum tankers discharge the collected sewage into the environment. As these disposal sites are located over the highly permeable recharge areas of the West Bank aquifers, these disposals pose a clear threat to the groundwater quality in the West Bank (Rishmawi et al., 2004). In the Gaza Strip, the main discharge sites are located primarily around Wadi Gaza and along the southern coastline.

The lack of effective wastewater treatment leads to deteriorating nature, biodiversity and groundwater quality and endangers public health (ARIJ, 2007). The improper treatment of sewage and wastewater remains the single most detrimental factor behind the spread of infectious and parasitic diseases in many Palestinian communities. The flooding of collection systems (cesspits, open channels, and pipelines) can result in spillage of raw sewage in residential areas, encouraging the spread of pathogens and insect breeding. This causes public health risks through direct exposure, as well as the reuse of untreated wastewater on irrigated lands. The pollution of the water aquifer in Gaza has the potential to significantly degrade the drinking water supplies for almost 1.5 million Palestinians.

The Israeli occupation prevents an effective management and operation of wastewater treatment infrastructure in the oPt, including the maintenance of existing and construction of new infrastructure (World Bank, 2009:20; ARIJ, 2007:118). Since the current governance system under the Oslo Agreement requires the Israeli approval of any proposed management measure or infrastructure project related to water and wastewater, and since the Israeli authorities have withheld this approval in several occasions, an integrated planning and management of water and wastewater infrastructure is essentially impossible (World Bank, 2009).

4.3.2 Potential environmental improvements

The wastewater volumes produced amount to 66 MCM/ year in 2006 (ARIJ, 2007). For the purpose of the benefit assessment and to determine the state of the environment in 2020, it was assumed that the wastewater volumes will increase proportionally with population growth.

According to the EU Urban Waste Water Treatment Directive (CEC, 1991), the establishment of waste water management plants is less feasible in terms of costs and management for settlements below 2,000 inhabitants. However, as we do not have any information on the percentage of population living in settlements below 2,000 inhabitants, the following estimates are based on the total population. This can result in a slight overestimation of the benefits.

Assuming a population growth rate of 2.71%, 5.5 million people will be living in the oPt by 2020. To estimate the baseline 2020, it is assumed that the proportion of treatment levels in 2006 remains the same in 2020. Table 4-9 shows the estimation of population connected to the different types of wastewater treatment plants in 2020 in comparison to 2006 levels.

Table 4-9 Wastewater treatment connection of population

Population of oPt (mil)	Population not connected to wastewater treatment facilities	Population connected to primary treatment	Population connected to secondary treatment	Population connected to tertiary treatment	Total
2006	2.96	0.83	0.15	0	3.98
2020 (estimated)	4.10	1.15	0.21	0	5.45

Source: ARIJ, 2007; 2010c; author's calculations

Alternatively, the baseline 2020 estimation can be done for the volumes of wastewater, instead of for the connection levels. Applying the same assumptions as mentioned above and assuming that wastewater volumes increase linearly with population growth, Table 4-10 summarizes the estimations of wastewater volumes treated to different levels in 2020 in comparison to the 2006 level.

Table 4-10 Volumes of wastewater under types of treatment, 2008 and 2020 (estimated)

Volumes of wastewater (million m³/year)	Volume untreated	Volume under primary treatment	Volume under secondary treatment	Volume under tertiary treatment	Total Volume
2006	38	25	2.52	0	66
2020	53	35	3	0	91

Source: MoEP, 2010c; author's calculations

This 2020 baseline is then compared to a policy scenario in which 100% of the wastewater is treated to at least secondary level.

4.3.3 Qualitative assessment of the benefits of improving waste water treatment

The qualitative benefits of improving waste water treatment are summarized in Table 4-11.

Table 4-11 Qualitative description of the benefits of improved wastewater treatment

Health benefits	Most health benefits are related to sewage collection, rather than treatment per se, as sewage that is not appropriately collected can cause significant health problems (such as diarrheal diseases, dysentery etc). These benefits are therefore assessed under the 'sewage connection' parameter and not here, to avoid duplication.
Environmental benefits	- The increased and improved treatment of wastewater is expected to reduce nutrient discharges into surface water bodies (freshwater and coastal water) and, therefore, reduce eutrophication in aquatic ecosystems, such as the Wadis. It must be noted that nutrient removal does not just arise from tertiary treatment. Significant removal is also achieved with secondary treatment. - The danger of untreated wastewater infiltrating into the soil and damaging aquifers and river systems is significantly reduced through improved wastewater treatment. - Further, treated wastewater can be used to substitute surface and groundwater sources for irrigation, resulting in a number of benefits which are further described under 'water scarcity'.
Economic benefits	- As many drinking water sources are derived from rivers or groundwater aquifers which are currently being damaged or could be damaged in the future, a reduction of contaminants in the abstracted waters can substantially reduce the costs of treatment for potable water. - Moreover it can be anticipated that, thanks to increased/improved water treatment, surface water should be more suitable for economic uses, e.g. for industrial water uses. This will bring significant direct cost reductions to water intensive industries in particular. - Economic benefits can be further derived from the use of grey water for irrigation. For one, the production of this water is cheaper, for the other grey water can substantially contribute to increasing water security. The benefits are further detailed under 'water scarcity'. - Furthermore, the investment in environmental technology and improvement in the skills of those working in the water industry will assist in enhancing the economic base of the country.

Social benefits	Most health benefits are related to sewage collection, rather than treatment per se), such as nuisance related to odours from direct discharge of sewage in the environment, etc. These benefits are therefore assessed under the 'sewage connection' parameter and not here, to avoid duplication.

4.3.4 Quantitative assessment of the benefits of improving waste water treatment

Achieving the target of treating 100% of the wastewater at least at secondary level would result in substantial quantitative benefits.

The achievement of this target in 2020 would result in 5.25 million inhabitants being connected to at least secondary treatment plants, in addition to those already connected (i.e. total of 5.46 million people). In comparison, the hypothetical achievement of this target in the baseline year of 2006 would have necessitated the additional connection of 3.79 million inhabitants to at least secondary treatment plants.

Further, the achievement of this target would result in an additional 87.9 MCM of wastewater being treated at least at secondary level, of which 53 MCM and 35 MCM would have remained untreated or treated at primary level only otherwise. For the hypothetical achievement of this target in the baseline year of 2006, an additional 63 MCM of wastewater would have had to be treated to at least secondary levels.

The achievement of this target in 2020 would result in an environmental improvement of 96.2%. This implies that of the total generated wastewater in 2020, 96.2% will be treated additionally to at least secondary level, instead of remaining untreated or treated only at primary level. Similarly the achievement of this target implies that 96.2% of the total population in 2020 will be connected to at least secondary treatment plants, while they would remain unconnected or connected to a primary treatment plant without the achievement of this target.

4.3.5 Monetary assessment of the benefits of improving waste water treatment

This study has not attempted to monetize the benefits of improving waste water treatment due to the complexity of the task and the budgetary constraints of the project. However, some benefits are assessed in relation to sewage connection (see above).

4.4 Benefits from reducing water resource scarcity

4.4.1 Current state of water resource use

In both the West Bank and the Gaza Strip, groundwater constitutes the main source of water. Rainfall is the dominant source of water, of which 68% evaporates and the remaining 32% percolate into and thus replenish the aquifers. A small amount drains off as surface runoff (Salmi, 1997). The main groundwater bodies underneath the West Bank comprise the

Western Aquifer System, the North-eastern Aquifer System and the Eastern Aquifer System. This groundwater is mainly used for domestic and irrigation purposes by the communities in the West Bank and Israel. The main aquifer system in the Gaza Strip is the Coastal Aquifer, which includes the Gaza Aquifer.

Around 850 MCM of renewable water are available each year in the oPt. As shown in Table 4-12, just one tenth of this (87 MCM) is surface water. Of these 87 MCM/year, 72 MCM/year are produced internally in the West Bank, whereas surface water produced internally is negligible in the Gaza Strip.15 A total of 15 MCM (17%) of total surface water in oPt flows from Israel into the Gaza Strip. While the Jordan River is the only perennial river in the oPt, this water is unavailable to the oPt as it merely consists of brackish water and Palestinians are denied access to it. Groundwater recharge provides a further 750 MCM of renewable water resources for the aquifers shared between Israel and the oPt. Of this, around 694 MCM/year are estimated to be internally produced in the West Bank and 46 MCM/year in the Gaza Strip.16 The remaining 10 MCM/year of groundwater flow from Israel into the Gaza Strip (FAO, 2009). However, according to World Bank estimates, Palestinian abstractions only account for some 20% of the groundwater produced in the West Bank (between 138 MCM in 1999 and 113 MCM in 2007) (World Bank, 2009). No desalinated water is produced in oPt in centralised, public plants that feed into the water supply network. However, there is some private and decentralised desalination to account for the deteriorating quality and increased salinity of tap water. Around 10 MCM of treated wastewater were reused in 2005 (FAO, 2007).

Table 4-12 Water resources in 2005/2007

Water Sources:	**Year**	**Water available ($10^6 m^3/yr$ = MCM/year)**
Surface water (SW)	2007	87
% SW from Israel	2007	17%
Ground water (GW) recharge	2007	750
% GW from Israel	2007	1.3%
Less overlap of GW and SW	2007	0
Desalinated Water	2005	0.00
Wastewater reused	2005	10
Total Actual Renewable Water		**850**

All data from FAO (2007) except % SW and from Israel and wastewater reused which is from FAO (2009).

According to the Palestinian Central Bureau of Statistics, in 2008, a total of 308.7 MCM of water were provided for the Palestinian population in the West Bank and Gaza from all sources (wells, springs and water purchased from the Israeli water company Mekorot). This

15 “internally produced surface water” refers to annual volume of surface water generated by direct runoff from endogenous precipitation.

16 “internally produced groundwater” refers to the long-term annual average groundwater recharge, generated from precipitation within the boundaries of the country (estimated by the annual infiltration rate).

compares to 335.4 MCM in 2007 and 319.1 MCM in 2006. In 2008, groundwater wells are the largest source of water, which provided 225.7 MCM/yr or about 73% (of which 66.3 MCM in the West Bank and 159.4 In Gaza). This was followed by the water purchased from Mekorot with a quantity of 57.8 MCM/yr, and finally the springs with annual discharge of 25.2 MCM (PCBS 2009). Out of 225.7 MCM pumped from groundwater wells, 120.3 MCM is used for domestic use (36.1 in West Bank and 84.2 in Gaza), and 105.4MCM is used for agricultural use (30.2 in West Bank and 75.2 in Gaza) (PCBS 2009).
Comparing the oPt water use of use 308.7 MCM to the 850 MCM that are available indicates a water exploitation index (i.e. total freshwater abstracted as a proportion of total renewable water available) of 36% in 2007. According to international measures, this indicates severe water stress and unsustainable use of water (Table 4-13).17 However, this number provides a distorted picture of the water situation: as noted above in chapter 4.1, Israel abstracts substantial amounts of water from the aquifers that it shares with the oPt, well in excess of the allocations fixed in the Oslo Agreement. These abstractions clearly exacerbate the existing water scarcity problem in the oPt.

With a population of 3.57 million in the oPt in 2005 (World Bank, 2010), 240 m^3 of water are available per capita/year. Total water use per capita is 120 m^3/year, of which 60 m^3/capita/year are used for municipal water use (see Table 4-13). According to FAO classifications, this indicates that the Palestinian population is living in conditions of 'absolute water scarcity'.18

Table 4-13 Water scarcity indices

Index	#	Unit
Water Exploitation Index	36%	Percentage water use to availability
Water Available per Capita	0.24	10^3 m^3/person/yr
Total Water Use per Capita	0.12	10^3 m^3/person/yr
Municipal Water Use per Capita	0.06	10^3 m^3/person/yr

Source: Author's own compilation, based on FAO(2007)

Note: Total water use per capita and water available per capita do not imply that this water is available as drinking water to the inhabitants. These availability and use data include total industrial, municipal and agricultural water usage.

Pressures on water availability include population growth, growth in agricultural and industrial production, as well as general economic development. These pressures continue to put a strain on the limited water resources available, both in terms of water quality and quantity. In recent years, the existing scarcity problem has been further exacerbated by repeated drought cycles, so that natural water resources were overused beyond their natural recharge (ARIJ, 2007).

17 Note that a WEI of over 20% implies water resources are under stress, and values above 40% imply severe stress and unsustainable use of water (Raskin et al, 1997)

18 FAO (2007) indicates that regions with water supplies below 1,700 m^3 per capita experience water stress, below 1,000 m^3 per capita experience water scarcity and below 500 m^3 absolute scarcity.

Since the 1967 occupation of the occupied Palestinian territory, all water resources in the oPt are under Israeli control and administration, which established a permit system for creation of new wells and maintenance of existing wells (ARIJ, 2007). The number of working wells in the West Bank has decreased from 413 in 1967 (Nasser, 2003) to 300 in 1983 (Israeli Ministry of Defence, 1983 in ARIJ, 2007) as a consequence of dropping water tables and as permits to rehabilitate wells or equipment could not be acquired (Nasser, 2003).
The rapidly increasing population in the Gaza Strip necessitated the increased abstraction of groundwater resources. Already by 1993, registered and unregistered wells extracted between 100 and 110 MCM/year from the Coastal Aquifer System, a number which greatly exceeded the estimated natural replenishment rate of 65 MCM/year (WRAP, 1994; ARIJ, 2007). The over-pumping of the aquifers in the Gaza Strip has resulted in seawater intrusion in the aquifers. 105 municipal wells and 4,000 agricultural wells are affected by high levels of chlorides ,floride and nitrate. Untreated wastewater percolating in the aquifer further poses a source of contamination and poses a threat to existing freshwater resources (see chapter 3.3).

Recent literature on water footprint analysis suggests that significant water savings can be made by changing the national production and trade structures to increase the production of water-efficient crops and decrease the production of water-inefficient crops.

The water footprint of a countries' agricultural production and trade structure is based on the "virtual water content" of the crops produced, which is the crop water requirement at field level (m^3/ha) divided by the crop yield. The crop water requirement is calculated per crop and per country by following the methodology developed by Allen et al. (1998). As the crop water requirement is defined as the "total water needed for evapotranspiration" and the virtual water content takes the crop yield into consideration, the water footprint of selected agricultural produces varies depending on agricultural efficiency and the climatic context in each country (Hoekstra and Chapagain, 2007, p. 145). The water footprint of the oPt agricultural production and trade structure is assessed by multiplying the quantities of the top ten agricultural products (in terms of tonnes produced) by their respective virtual water content. 19 To put these numbers into an international context and assess ways to reduce the oPt water use by changes in production and trade patterns, the virtual water content of the selected crops in the oPt is compared to the global average, as well as those in Spain, as a European benchmark with broadly comparable climatic conditions to the oPt.

Table 4-14 presents the comparison of water footprints for the top 10 produced crops in the oPt in 2008 with the average water footprints required in Spain and globally.

19 Agricultural trade and production data are taken from FAO (2011b), while data on the virtual water content for selected crops in Israel is taken from Hoekstra and Chapagain (2008). As there was no data on the country-specific water footprint for the OPT, the average of similar countries, namely Algeria, Egypt and Morocco, was applied.

Table 4-14 Comparison of Water Footprints for Top 10 produced crops in oPt (m³/t)2021

Crop	Production Quantity (t) (2008)	Area Harvested Ha) (2008)	Water footprint – Average Algeria, Egypt & Morocco (m3/t) (1997-2001)	Water footprint Spain (m3/t) (1997-2001)	Water footprint Global Average (m3/t) (1997-2001)
Cucumbers and gherkins	208,182	3,235	258	64	242
Tomatoes	207,559	2,492	205	53	184
Olives	85,770	90,090	6641	3295	4393
Potatoes	69,180	2,118	387	202	255
Eggplants (aubergines)	59,655	1,171	483	152	208
Grapes	55,164	7,400	1669	1338	655
Onions, dry	40,054	1,733	372	82	346
Wheat	39,799	22,944	4206	1227	1334
Oranges	38,428	1,604	768	362	457
Cauliflower and broccoli	24,840	869	139	56	159

Source: adapted from Hoekstra and Chapagain (2008); FAO, 2011b; Author's compilation

This comparison shows that all selected crops, except cauliflower and broccoli, have higher water footprints than the Spanish and global average. The crop category "cauliflower and broccoli", require on average 13% less water than the global average, but still 148% more than the Spanish average. The crops requiring most water, namely olives, grapes and wheat, require 51%, 155% and 215% more water than the global average respectively and 102%, 25% and 243% more water than the Spanish average respectively.

Analysing the historic development of production patterns of these crops with high water requirements, it becomes apparent that in 1995, only grapes were among the top 10 produced crops, with 40,912 t/year. In 2000, the production of grapes increased to 59,260

20 The crop category "Pumpkins, squash and gourds" has been excluded in this tabular overview, as no data on their waterfootprint was readily available. This crop category is ranked seventh, with 50,578 tonnes produced in 2008.
21 As the water footprint data was accumulated for the period of 1997-2001, the water savings described do not consider technical efficiency improvements.

t/year, while 53,422 t/year of wheat and 38,463 t/year of olives were produced. The production changes between 2000 and 2008 had a significant impact on water usage in agriculture. The production of olives increased to 85,770 t/year in 2008, which increased overall water usage from 255,432,783 m³ to 569,598,570 m³, an overall increase of 123%. On the other hand, the production of wheat and grapes has decreased between 2000 and 2008 decreasing the water used by 57,298,338 (26%) and 6,836,224 (7%) respectively. Thus, there is no clear trend regarding production changes towards water-efficient crops.

4.4.2 Potential environmental improvements

Determining a water resource "no action" baseline for 2020 for any country is rather difficult due to the multitude of complex factors influencing water supply and demand, requiring a much more detailed assessment than what is possible in the frame of this broad, cross-cutting analysis.

Table 4-15 shows the current situation (2007) and the estimates for the 2020 baseline on water use and water sources. The scenario 2020 assumes that the water use in the various sectors increases proportionally with population growth. The baseline estimates for 2020 assume an increase in the population from 3.94 million (2007) to 5.45 million (2020) (World Bank, 2010). Annual precipitation rates are deemed likely to fall in the eastern Mediterranean, decreasing 10% by 2020 and 20% by 2050, with an increased risk of summer drought which would exacerbate the problem of water scarcity (Mimi, Mason, & Zeitoun, 2009). However, as there is no regional climate modelling with a sufficient spatial resolution, and no reliable forecasts on the expected impact of decreased precipitation on water availability at this stage (SUSMAQ, 2003), we refrained from quantifying the impact for 2020 for the purpose of this assessment, which is not to say that such impacts are considered unlikely.

Table 4-15 Water demand and supply in oPt, in 2005/7 and the baseline 2020 case

	Water Use (Total annual withdrawal (10^6 m³/yr)					Water Sources (Water available - replenishment (10^6 m³/yr)				
Year	Agriculture	Municipal	Industry	Nature	Total	Surface	Groundwater	Desalinated	Wastewater reused	Total
2007	189	200	29	**/**	**418**	87	750	/	10	**850**
2020	261	276	40	**/**	**577**	87	750	/	10	**850**

Source: FAO, 2011a

This data translates into the indicators presented in Table 4-16, to provide clearer insights on the water scarcity situation:

Table 4-16 Key Indicators on water use and water availability

Year	Water Available per Capita (10^3 m3/person/yr)	Water Exploitation Index (%)	Total Water Use per Capita (10^3 m3/person/yr)	Municipal Water Use per Capita (10^3 m3/person/yr)
2007	0.24	49	0.12	0.06
2020	0.24	68	0.16	0.08

Source: Author's calculations

In terms of establishing targets, due to the complexity of water resource use and management and the considerable contextual variation between and within countries, it is neither practicable nor useful to set a specific, universal target for the water exploitation index.

However, the EU suggests that countries should, where appropriate, aim to lower their WEI towards 20-40%. A reduced WEI should allow more water to be available to maintain and enhance wetlands and water bodies with improved biodiversity and ecosystem services (e.g. fisheries, recreation and navigation etc).

What is more important is that a sustainable, "demand-led" approach to "integrated water resource management" is adopted, focusing on conserving water and using it more efficiently. In addition, the following Millennium Development Goals should also be targeted:

a. Ensure appropriate environmental flows are ensured to maintain wetland ecosystem goods and services;
b. Change social, economic and regulatory instruments that are inappropriate for water allocations and uses; and
c. Mediate water conflicts across the sectors through participation of appropriate stakeholder groups.

Potentially relevant actions to achieve the targets described above may include for instance repairing water distribution networks, drought management plans, re-using water, collecting water, charging adequate prices for water use (including agricultural use), etc.

As the comparative water footprint analysis above showed, oPt is producing crops which require water above the global and Spanish average water requirements. On the one hand, this is due to climatic conditions and on the other hand due to different agricultural practices (i.e. efficiency of irrigation). As agricultural water use amounts to 45% of total water use in the oPt, changes in the production patterns and practices can lead to substantial water savings. Future studies should follow this line of thought and support the oPt to better align its agricultural production patterns to its water resources situation.

4.4.3 Qualitative assessment of the benefits of improving water resource use

Improving water resource use and management will potentially lead to a multitude of benefits. The following benefits, which focus on alleviating water scarcity and optimising overall water use (as opposed to improving water quality), may be gained:

Table 4-17 Qualitative description of the benefits of improving water resource use

Health benefits	Reduced water scarcity can positively affect the achievements of the targets described in the drinking water, sanitation and hygiene chapter (see section 3.2)
Environmental benefits	- Decreased groundwater abstractions would reduce the further spread saline intrusion in the coastal aquifer, benefiting humans and the environment alike. - Improved water resource use could make some water available for the environment, e.g. for wadis, resulting in an improved functioning of the wadi ecosystems.
Economic benefits	- If less water is used due to demand management practices, there is less need to increase the production capacity of wells etc., freeing up the capital and operating costs. - Improved water resource use can lead to less crops and livestock being lost through droughts. The increased water security can motivate farmers to plant higher value multi-year crops, such as wine, for which water security needs to be guaranteed. This also allows growing crops with higher agricultural capital accumulation (i.e. trees and other plants which take a significant amount to mature), which are more profitable than single season crops (Lavee, 2010)
Social benefits	For transboundary water bodies (in particular the Jordan River, but also groundwater bodies), a reduction in water use combined with a greater allocation of water to nature could also improve the conditions for alleviating existing conflicts over water use, if such arrangements can be achieved in the frame of an international agreement or treaty and the benefits shared equitably.

Source: Authors' own compilation

4.4.4 Quantitative assessment of the benefits of improving water resource use

This study has not attempted to quantify the benefits of reducing water scarcity through improved water resource management due to the complexity of the task and the budgetary constraints of the project.

4.4.5 Monetary assessment of the benefits of improving water resource use

This study has not attempted to assess the monetary value of reducing water scarcity through improved water resource management due to the complexity of the task, the limited data availability and the budgetary constraints of the project.

However, it is worth pointing out that the potential economic losses associated with droughts and reduced crop outputs can be substantial.

4.5 Case study relating to improved wastewater treatment, improved water resource use and improved drinking water supplies.

While untreated wastewater can be a major source of contamination of ground- and surface waters, wastewater which is collected and treated to acceptable standards can be a sustainable and valuable resource. By substituting high quality drinking water with treated wastewater for agricultural irrigation, water conservation is promoted while the freshwater supplies for domestic uses can be expected to be more reliable.

In the case of rural oPt, the construction of centralized wastewater treatment plants and collection networks are economically unfeasible due to the dispersed settlement patterns in rural communities and remote areas (Isaac Jad, 2009). On-site wastewater treatment units can be a feasible alternative, but due to the high costs of importing such units, they were only sparsely installed in rural areas. The Applied Research Institute – Jerusalem (ARIJ) developed an alternative solution to high-cost imports by developing the technology for small scale activated sludge wastewater treatment plants (SSWWT), which can be produced locally.

In a project starting in March 2007 and ending September 2010, which is coordinated by ARIJ and covers a total budget of EUR 881,752 (US$ 1,170,000), six locally made and six imported sludge filtration units were installed and tested. While the imported SSWWT units cost around EUR 17,175 (NIS 45,000), the locally produced ones could be developed with the same specifications at a third of the cost, around EUR 5,725 (NIS 15,000). Furthermore, the project revealed that, besides generating jobs in the occupied Palestinian territory, the locally produced SSWWT units produced higher quality treated effluent than the imported ones.

The project, which was funded by the Mennonite Central Committee, introduced SSWWT units in 18 villages around the Bethlehem and Hebron Governorates in the West Bank, which enabled 180 households (~1,800 people) to utilize wastewater treated to Palestinian standards as a substitute for drinking water in agricultural irrigation. In addition, the 180 households were supplied with suitable irrigation networks which are connected to the treated wastewater (ARIJ, 2011).

Qualitative Benefits

The wastewater in these 18 pilot villages is not released untreated into the environment anymore, benefiting ecosystems and public health. The additional fruit and crops produced support an improved food security generate jobs and lead to an increase of household income, which results in a number of secondary economic benefits, such as activating the local economy. This project further led to raising the awareness of the local communities to environmental problems and their potential solution (UNDG, 2010).

Quantitative Benefits

180m^3/ day of wastewater are now treated to Palestinian standards by the 180 households collectively. This treated wastewater is now used instead of drinking water to irrigate 115 dunums of fruit trees and other suitable crops. Agricultural production of fruits and other suitable crops has increased by 502kg/household/year to 722kg/household/year (UNDG, 2010).

Monetary Benefits

This increase in agricultural production has led to a rise in household income. The income related to food sales of the farming households has increased from EUR 100 (US$ 134) to EUR 332 (US$ 440) with the introduction of SSWWT units (UNDG, 2010).

Further quantification and monetisation of benefits is undertaken in chapter 6.3, in which the benefits of adaptation to climate change are assessed.

Lessons and Insights from Project

Besides the high cost of SSWWT units, the project revealed that the acceptance of communities, mainly due to the lack of awareness of the potential benefits arising and the importance of protecting or sustaining the environment, were the major constraints to introducing SSWWT units in Palestinian rural areas.

UNDG (2010) presumes that the success of the project is mainly due to the support of the Palestinian Authority (incl. The Ministry of Agriculture and Water Supply & the Sewage Authority), the technical option to reduce costs by producing the SSWWT units locally, and finally, the fact that the SSWWT units can be easily implemented by the communities and can be scaled-up easily.

5 BENEFITS OF IMPROVING SOLID WASTE RELATED CONDITIONS

5.1 Introduction to waste related issues

Municipal Solid Waste (MSW) is a significant contributor of environmental and health related problems in the occupied Palestinian territory, and waste management in the Palestinian authority is still at its infancy. Between 1967 and 2004 existing waste infrastructure deteriorated and only limited development of new infrastructure took place. This has resulted in insufficient supply and limited service. There are only few sanitary landfills built to international standards, and the majority of the waste is dumped on random dumpsites without proper management or monitoring. The most pressing problems are an increase in air pollution, continued degradation of nature and biodiversity including increased salinity and heavy metal concentrations in the soil, an aesthetic distortion of the visual environment, and an overall lower quality of life for the Palestinian people (ARIJ, 2007).

Solid waste produced in the occupied Palestinian territory comes from a variety of sources. The majority of the waste produced is household waste. In terms of specialised waste streams, there are smaller fractions of e.g. hazardous waste (e.g. motor oil and batteries); industrial waste, both hazardous and non-hazardous; infectious medical waste from hospitals and medical laboratories; agricultural waste, including plastic waste and left over agro-chemicals, and construction and demolition debris from the building sector.

In 2004, it was estimated that the number of dumping sites in the occupied Palestinian territory has risen to some 450 sites. In most cases, neither the location nor the set-up of the dumping sites is selected in accordance with minimal environmental, health or economic considerations. Most solid waste dumping sites are unlined, which causes leachate to seep into the ground and may pollute the groundwater aquifers. Small, randomly located dumpsites are common, and most small villages have at least one. For these dumpsites, there is typically no monitoring or control by the Palestinian Ministry of Health or other authorities. Solid waste is also often burned on the site to reduce the bad odours, thereby adding to air pollution by leading to emissions of acidifying and greenhouse gases. Biological degradation of remaining unburned organic waste adds to their emissions by generating landfill gases. Burning medical waste may pollute air with various heavy metals, especially cadmium, mercury, and dioxins that form through burning PVC (ARIJ, 2007).

The Israeli Occupation exacerbates the existing problems of domestic and industrial waste management, for a number of reasons. First of all, sanitary landfill sites in the West Bank would typically be constructed in rural areas (remote from densely populated cities), which are typically located in “Area C” and therefore require permits and licenses from the Israeli administration. The difficulties in acquiring these permits and lack of coordination with the Israeli Civil Administration are hindering the set-up of such landfills (Palestinian National Authority, 2010). Secondly, effective waste management is hindered by the geographical discontinuity of land under Palestinian control (most clearly evidenced by the segregation wall). Thirdly, the Israeli settlements in the West Bank are reported to release solid waste into the surrounding Palestinian environment without effective controls or restrictions, as the Palestinian administration has no authority to regulate or control, and the enforcement of Israeli regulations by the Israeli Civil Authority is rather poor (Palestinian National Authority, 2010).

Finally, a number of Israeli industrial facilities have relocated to the West Bank, taking advantage of the weaker environmental regulations and the laxer enforcement there. There are approximately 160 Israeli factories, divided into 13 “industrial zones” established in the West Bank (Sabeel 2007). Special locations were designated around these to dispose waste from these industrial zones. This includes the burial of materials such as zinc, nickel, radioactive substances and industrial waste. Industrial wastewater contains several hazardous pollutants which harm the environment, including heavy metals such as chromium, copper, and zinc (ARIJ, 2007). It should be noted that reliable data on these impacts is difficult to obtain, and mostly limited to anecdotal evidence.

Hazardous waste is produced mostly in industrial and medical activities. Only a small amount of industrial waste is recycled, and most is burned on-site. If it is not burned, the industrial waste is disposed of through the wastewater system and eventually ends up being discharged untreated into the environment. Medical waste comes in many different forms and a significant percentage of it is considered hazardous. About 80% of the medical centres in the West Bank do not control the disposal of their waste, and usually it is burned or added to the municipal waste. Many pesticides used for agricultural purposes constitute as hazardous waste and persistent organic pollutants (POPs), and there is a large underground network of selling pesticides that contain illegal chemicals. Polychlorinated biphenyls used in electrical installations, building materials with asbestos, dioxins, household and battery waste are all common forms of hazardous waste. Unfortunately no inventory of hazardous waste substances exists in the oPt; this makes it difficult to determine what types of waste are being disposed of and where they are being disposed (ARIJ, 2007).

This section will cover the following aspects of waste management:

- Waste collection coverage
- Illegal /uncontrolled dumping of waste
- Methane emissions

Waste prevention is a key factor of the EU waste management strategy and should be a key factor in any waste management strategy. However, for methodological reasons, the benefits of waste prevention have not been assessed under this project.

5.2 Benefits from improving the waste collection coverage

5.2.1 Introduction to waste collection benefits

Benefits from enhanced collection of municipal solid waste are calculated by comparing the 2020 situation in case of business-as-usual with the future situation in which a higher level of collection coverage would be reached. As a target we assume 100% collection coverage in

2030. In the year 2020 collection coverage is assumed to be augmented in such a way that the 2030 target can be reached. Increased collection coverage leads to avoided environmental impact from non-collected waste, or to a decrease of dumped waste in non-controlled or wild dumpsites. Socio-economic benefits are found in increased employment and in an increased service of which the value can be assessed by the willingness-to-pay of the supplementary served population.

5.2.2 Current state of the waste collection system

According to a 2005 survey, the overall availability of residential solid waste was 89%, which is quite high in comparison to other developing countries. However, the quality of this collection service varies significantly. According to the same study, nearly 50% of the households in the Palestinian Authority receive a collection service three or less times a week, which led to the accumulation of waste between collection periods, resulting in negative health and environmental impacts, such as the spread of unpleasant odours, insects, and rodents, as well as leachate dripping (Al-Khatib & Arafat, 2010; Al-Khatib et al., 2007).

In addition, nearly 50% of households in the Palestinian Authority have to travel 500 meters or more in order to dispose their waste, which creates a burden for households and often discourages them from dumping the waste in the designated containers. In some cases households turn small open spaces close to their homes into makeshift waste disposal sites for their own use. On the other hand, in some cases waste containers are maintained or designed in such a poor shape, that they become a nuisance and even a health hazard to nearby households. These containers could cause problems such as leachate, odour and broken glass which induce respiratory and digestive diseases, as well as putting in risk children who pass by these containers and pick up objects which may endanger their health (Al-Khatib & Arafat, 2010).

Within the remaining households which do not benefit from a waste collection service (approximately 10%), about 20% burn their waste (mainly to reduce its volume), which releases toxic and carcinogenic gases such as dioxins, especially if the waste contains plastic materials (Al-Khatib & Arafat, 2010; Al-Khatib et al., 2007). Within the remaining households, another 30% dispose the waste in common or random open dumpsites, which usually start as a convenient makeshift dump areas by some residents. Thus, neither the location of these dumpsites nor their set-up is subject to the minimal environmental or health standard (Al-Khatib & Arafat, 2010).

Hence, much potential lies in improving the state of waste collection in the Palestinian Authority, both in terms of expanding the collection coverage and in terms of improving the quality of waste collection services and facilities.

Average waste generation

oPt counts 3.937.309 inhabitants. The total waste generation is 1.100.000 ton/year. The calculated average waste generation is thus **279,4 kg/inh.year.**

Waste collection coverage

The waste collection service coverage is 90% for the whole country.

Population growth and GDP growth
Population growth is assessed at a yearly increase of 2,71%
GDP growth is assessed at a yearly increase of 4,9%[22]

Not collected amount of municipal waste
When multiplying the total number inhabitants non-covered by collection with the average municipal waste generation per inhabitant, we can assess the total amount of municipal waste which is not collected and thus presumed dumped or incinerated in a non controlled way.

$$W_{nc} = A_q * T_{pop} * \frac{(100 - CC)}{100}$$

W_{nc}: Total amount of waste that is yearly not collected and thus presumed dumped or burned in a non controlled way
A_g: Average waste generated in ton/capita/year = 0.279
T_{pop}: total population = 3,937,309 inhabitants
CC: % of collection coverage = 90%

W_{nc} = 0.279 * 3,937,309 *[(100-90)/100] = **0.11 million ton/year**

5.2.3 Potential environmental improvements

Baseline Scenario
The baseline from now to 2020 is a business-as-usual situation in which the collection coverage does not increase or decline. It is fully defined by demographic evolution and by the evolution of the average generation of waste per capita, in line with augmenting GDP. This leads to following results, presented in Table 5-1:

22 Source : http://data.un.org/CountryProfile.aspx?crName=Occupied%20Palestinian%20Territory

Table 5-1 Baseline total municipal waste generation

	population	GDP	kg/inh.year	tonnes/year
2008	3.937.309	4,18	279,4	1.100.000
2009	4.044.010	4,39	293	1.185.171
2010	4.153.603	4,60	307	1.276.936
2011	4.266.165	4,83	322	1.375.806
2012	4.381.778	5,06	338	1.482.332
2013	4.500.525	5,31	355	1.597.106
2014	4.622.489	5,57	372	1.720.767
2015	4.747.758	5,84	391	1.854.002
2016	4.876.423	6,13	410	1.997.554
2017	5.008.574	6,43	430	2.152.220
2018	5.144.306	6,75	451	2.318.862
2019	5.283.717	7,08	473	2.498.406
2020	5.426.905	7,42	496	2.691.853

Source: Authors' own estimation based on Benefit Assessment Manual (Bassi et al. 2011)

To calculate the amount of waste that is not collected and thus presumed dumped or incinerated in a non controlled way in 2020, the following formula is used

$$W_{nc}^{2020} = A_q^{2020} * T_{pop}^{2020} * \frac{(100 - CC_{2008})}{100}$$

- W_{nc}: Total amount of waste that is yearly dumped or burned in a non controlled way, in 2020
- A_g: Average waste generated in tons/capita/year in 2020 = 0.496
- T_{pop}: total population in 2020 = 5,426,905
- CC: % of collection coverage in 2008: the baseline assumes no shifts in the actual collection systems = 90%

W_{nc} for 2020 = 0.496 * 5,426,905 * 0,10 = 0,269 million ton/year

The amount of waste yearly dumped or burned in a non-controlled way under the baseline scenario in 2020, is 0,269 million tonnes.

Waste Composition

When assuming a shift in the composition of the generated municipal waste between now and 2030, in line with shifts in lifestyle, the future generation of different waste fractions can be calculated (see

Table 5-2). Table 5-3 and Table 5-4 (below) present how this shift in municipal waste composition will evolve between 2008 and 2020, in percentages and in tonnes per year, respectively.

Table 5-2 Baseline shift in waste composition

	Actual composition (%)	Future composition 2030 (%)

Organic waste	60,5	44,0
Plastics	6,5	13,0
Paper/cardboard	7,3	16,0
Metals	2,5	5,0
Glass	2,8	9,0
other	20,0	13,0

Source: Authors' own estimation based on Benefit Assessment Manual (Bassi et al. 2011)

Table 5-3 Baseline municipal waste composition

	organic	plastic	paper	metals	glass	other
2008	60,5	6,5	7,3	2,5	2,8	20,0
2009	59,6	6,7	7,5	2,6	2,9	19,6
2010	58,8	6,9	7,8	2,7	3,1	19,2
2011	57,9	7,1	8,1	2,7	3,2	18,9
2012	57,1	7,4	8,4	2,8	3,4	18,5
2013	56,3	7,6	8,7	2,9	3,6	18,1
2014	55,5	7,9	9,0	3,0	3,8	17,8
2015	54,7	8,1	9,3	3,1	4,0	17,4
2016	53,9	8,4	9,7	3,2	4,2	17,1
2017	53,1	8,6	10,0	3,3	4,5	16,8
2018	52,3	8,9	10,4	3,4	4,7	16,4
2019	51,6	9,2	10,8	3,5	5,0	16,1
2020	50,9	9,5	11,2	3,6	5,3	15,8

Source: Authors' own estimation based on Benefit Assessment Manual (Bassi et al. 2011)

Table 5-4 Baseline municipal waste fractions generation

tonnes/year	total	organic	plastic	paper	metals	glass	other
2008	1.100.000	665.500	71.500	79.750	27.500	30.250	220.000
2009	1.185.171	706.724	79.502	89.073	30.578	34.397	232.438
2010	1.276.936	750.501	88.399	99.486	34.000	39.112	245.579
2011	1.375.806	796.991	98.292	111.116	37.805	44.474	259.463
2012	1.482.332	846.360	109.293	124.105	42.036	50.571	274.132
2013	1.597.106	898.787	121.524	138.613	46.740	57.503	289.630
2014	1.720.767	954.462	135.125	154.817	51.971	65.386	306.005
2015	1.854.002	1.013.585	150.247	172.915	57.787	74.349	323.305
2016	1.997.554	1.076.371	167.062	193.129	64.255	84.542	341.584
2017	2.152.220	1.143.046	185.758	215.706	71.446	96.131	360.895
2018	2.318.862	1.213.851	206.548	240.923	79.441	109.309	381.299
2019	2.498.406	1.289.042	229.663	269.087	88.332	124.294	402.856
2020	2.691.853	1.368.891	255.366	300.543	98.218	141.333	425.632

Source: Authors' own estimation based on Benefit Assessment Manual (Bassi et al. 2011)

Targets

The target is full collection coverage of the total population, rural and urban, in 2030. Increased collection leads to less waste sent to wild dumpsites or wild burning, and thus a reduced negative impact on the environment and human health.

Collection Coverage:

- 90% of the population covered by municipal waste collection in 2008
- 100% of the population covered by municipal waste collection in 2020

Environmental Improvements

The environmental improvement of reaching the collection targets is based on the amount of waste for which non-controlled disposal is avoided. It is the difference between the total amount of collected waste in the business-as-usual scenario in 2020 and the total amount of collected waste in the collection-coverage-target compliant scenario in 2020 (Table 5-5). We are assuming that according to the target-compliant-scenario, collection will evolve towards 100% coverage of all waste generated in 2030.

Table 5-5 Collection coverage and total non-collected waste in Baseline and in Target Compliance scenarios, 2020.

	Baseline Scenario	Target Compliance Scenario
Tonnes of waste collected in 2020	2,422,667	2,565,975
Percentage of waste collected in 2020	90%	95,3%
Difference : environmental benefit in tonnes of waste		143,308

Source: Authors' own compilation

Total environmental improvements: 143,308 tonnes of waste collected.

5.2.4 Qualitative assessment of the benefits of improving waste collection

Health benefits	- Health benefits can emerge from avoided pollution of soil, ground water and air by wild dumping, such as the spread of unpleasant odours and insects. Illegal dumps can also attract rodents, which are a major factor in the spread of insect-borne and gastro-intestinal and parasitic diseases (such as gastroenteritis and malaria). - In addition, centralized waste collection can reduce the burning of illegal dumpsites (which is done to reduce the volume of waste), that leads to the release of toxic and carcinogenic gases such as dioxins, especially if the waste contains plastic materials. For example, in Ramallah city, the burning of residential solid waste within the city boundaries leads the creation of large clouds of smoke covering significant portions of the city (especially when

	strong wind is blowing). - Furthermore, where there are cases of local population involved in informal waste collection (especially children), which can lead to contamination due to the handling of waste materials. This becomes especially problematic when municipalities and village councils dispose their medical waste in the same dumps mixed with MSW without proper segregation and treatment.
Environmental benefits	- Improving waste collection (in terms of service and quality of infrastructure), can prevent the pollution of soils and water resources. For example, it is common to see leachate dripping from waste containers in the oPt, which pollutes the soil and can infiltrate to groundwater, the main source of water for the population living in the West Bank. The occasional burning of waste also leads to long-term environmental effect on air and water quality.
Economic benefits	- Economic benefits will be derived from realizing health benefits (e.g. in improved air pollution) and environmental benefits (e.g. in minimizing threat to groundwater quality). - In addition, centralizing waste collection and diverting waste into landfills will lead to job creation (see quantitative assessment of waste treatment – section 1.3.4 below).
Social benefits	- The accumulation of waste nearby residential areas is a nuisance to society, which decreases the quality of life and puts at risk vulnerable populations (e.g. children who pick up harmful waste). - Additional social benefits include the creation of jobs in waste collection and in the construction and maintenance of landfills (see quantitative assessment of waste treatment – section 1.3.4 below). In addition, the closure of illegal dumpsites will increase social welfare in villages in the vicinity of the dumpsites.

5.2.5 Quantitative assessment of the benefits of improving waste collection

The quantitative assessment of environmental benefits focuses on the benefits of reducing the size of land polluted by uncollected waste/dumpsites, thanks to the expansion of the collection coverage.

The Following assumptions are used:

- Average dumpsite depth of 1 meter
- Average density of dumped waste of 340 kg/m³
- Reduction in volume through biodegradation and uncontrolled fires at the dumpsites with 2/3

The total size of uncontrolled dumpsites avoided by expanding the collection coverage to 100% in 2030 is calculated as follows :

Total non collected municipal waste generated in 2020 (kg) * 1/3 * 1/340 = 0,14 million tonnes * 1/3 * 1/340 = 140.498 m² polluted land avoided

A rough assessment of economic benefits can be done by estimating the impact on job creation of an expanded waste collection system. The collection efficiency on a waste loader is about 179 tonnes/year.23 Since the additional waste collected in the target compliant scenario is 143,308 tonnes (see above), an addition of 800 trucks will be needed every year to collect this waste. This will create an additional 1,601 jobs for waste collection, plus some supplementary jobs for management and support (see Table 5-6 below). It should be mentioned that more developed techniques, like bring systems and once-per-week collections, can decrease the job creation.

Table 5-6 Additional jobs and wages created from the environmental improvements resulting from 100% collection coverage

tonnes/year of waste truck	additional waste collected (tons)	additional annual trucks	additional jobs created
179	143,308	800	1,601

Source: Authors' own compilation

5.2.6 Monetary assessment of the benefits of improving waste collection

We assume that any household not receiving waste collection services will be willing to pay 1% of their income for waste management.

The monetary value of extended waste collection coverage can thus be calculated using the willingness-to-pay (WTP) value for waste collection:

- The average annual income in the Palestinian territory is EUR 3,441 (DWRC/Global Policy Network, 2006). This is the national average, and may be an exaggeration as most people supplementary served will be rural people with lower average incomes. However this exaggeration can be compensated by applying the average income of 2006 on the year 2020 without taking into account the increase in GDP
- 5,32 % of the total population in 2020 will be supplementary served with municipal waste collection, that is 5,426,905 * 5.32% = 288,711 inhabitants
- This population represents an income of 288,711 * € 3,441 = € 993,454,551
- Willingness to pay would be 9,934,545 euro.

5.3 Benefits from improving waste treatment

23 This figure is based upon daily collection, using small recipients and using a modern small compacting truck with a capacity of 90 kg/h. An average working day for waste collector counts 7 hours, and a work year in Palestine counts 284 days (Arij, 2007).

5.3.1 Current state of waste disposal and treatment

Uncontrolled dumping of MSW

Most of the waste in the occupied Palestinian territory (about 69%) is dumped in random dumpsites, which by majority started off as a makeshift dump area by some local residents and expanded thereafter. Hence, neither the location nor the set up of these dumpsites are subject to minimal health or environmental standards. It is estimated that some 450 illegal dumpsites exist in the oPt (World Bank 2004), and that the amount of dumpsites has increased significantly after 2000, partially due to the increased amount of roadblocks created by the IDF during (and after) the Second Intifada which has reduced mobility significantly within the West Bank (Al-Khatib u. a., 2007).

Although most of these dumpsites were once located in rural sections, the expansion of urban areas led to increased proximity of these dumpsites to residential areas, which intensifies the impact of health hazards created by these dumpsites. As mentioned above, the environmental supervision and monitoring of these dumpsites is poor. It is estimated that 79% of the dumpsites are not subject to any environmental supervision, that 86% of them are not subject to health control and monitoring and that 77% of them do not have the proper license for construction (Al-Khatib & Arafat, 2010). As a results of this poor control leachate is dripping which contaminates underground water (the main water resource for the West Bank); emissions of acidifying and greenhouse gases are generated from biodegradable waste, which can be intensified when these dumpsites catch occasional fires which releases toxic and carcinogenic gases from the burning of plastic materials; insects and rodents are attracted, which increases the spread of insect-borne and parasitic diseases, and so on.

A number of institutional and policy barriers contribute to the above mentioned situation. On the one hand, the responsibility for monitoring these dumpsites and for providing license for their construction is dispersed among a number of governmental authorities, such as the Palestinian Ministry of Health, Ministry of Local Government and the Environmental Quality Authority. On the other hand, in 70% of the cases it is the local municipalities which are in charge of waste collection and transfer, and they often lack the capacity to collect fees for waste collection or to mobilize financial and organizational resources for waste management altogether. In addition, partial use of these dumpsites by the Israeli Military, and to a greater extent by the Israeli settlements, significantly contributes to the growth of uncontrolled and unmanaged dumpsites, as neither of these entities is supervised (sufficiently) by the Israeli nor by the Palestinian authorities.

Landfilling

Over the last decade there have been improvements in waste treatment in the Palestinian Authority - a number of sanitary landfills have been built to international standards. In total, it was estimated in 2004 that 30% of the MSW in the Palestinian Authority is being landfilled (World Bank, 2004).

In the majority of cases, finance for these projects comes from international donor organizations. Three landfills have been set up in the Gaza strip, where land is particularly a scarce resource: Jahral-Dik, Deir al-Balah and Rafah in southern Gaza. The central landfill is

equipped with synthetic-liner with leachate collection systems (ARIJ, 2007, S. 128). In the West Bank, a landfill has been set up near Jericho, which was marked as success story leading to significant environmental and social benefits. An additional landfill was set up near Jenin (Zahrat Al-Funjan), and plans for construction of more landfills are ongoing (Palestinian National Authority, 2010). According the National Environmental Strategy 2000, 3-5 sanitary landfills are proposed for the West Bank. According to the National Solid waste management strategy 2010, four sanitary landfills are foreseen in West Bank (North West Bank-Jenin (in operation since 2007), Center West Bank -Ramallah (ongoing), Southern West Bank-Hebron (ongoing), Jerusalem) and one to two in Gaza Strip. Moreover EQA and MOH in cooperation with UNDP are planning to construct an autoclave to treat the medical waste generated from Ramallah hospital.
In addition, Israel manages two landfills in the occupied Palestinian territory, one near Jerusalem (Abu Dis) and one in the Jordan Valley (Tuvlan). These landfills mainly serve the Israeli settlements, and to a lesser extent the surrounding Palestinian communities . Both of these landfills are not subject to the environmental and health standards imposed on landfills in Israeli territories.

Recycling and composting

There is virtually no public recycling systems in the Palestinian Authority. Several private initiatives for recycling are in place, such as the collection of scrap metals from waste collection containers and dumps, which is then shipped to Israel for re-manufacturing, or the recycling of disposable beverages (Al-Khatib et al., 2007). In addition, Nablus has some capacity for recycling old cars and car wrecks (ARIJ, 2007, S. 129). Overall, it is estimated that about 1% of the MSW in the oPt is being recycled (World Bank, 2004).

5.3.2 Potential environmental improvements

Baseline

The baseline scenario describes what will happen if average waste generation grows in line with GDP and if total waste generation grows in line with demography, as described above, and if the actual waste treatment options remain unchanged (see Table 5-7).

Table 5-7 Baseline scenario for waste treatment

	waste generated	collection coverage	waste collected	waste not collected	dumped (tonnes)	landfilled (tonnes)	incinerated (tonnes)	recycled (tonnes)	composted (tonnes)
2008	1.100.000	90	990.000	110.000	683.100	297.000	0	9.900	0
2009	1.185.171	90	1.066.654	118.517	735.991	319.996	0	10.667	0
2010	1.276.936	90	1.149.242	127.694	792.977	344.773	0	11.492	0
2011	1.375.806	90	1.238.226	137.581	854.376	371.468	0	12.382	0
2012	1.482.332	90	1.334.099	148.233	920.528	400.230	0	13.341	0
2013	1.597.106	90	1.437.396	159.711	991.803	431.219	0	14.374	0
2014	1.720.767	90	1.548.690	172.077	1.068.596	464.607	0	15.487	0
2015	1.854.002	90	1.668.602	185.400	1.151.335	500.581	0	16.686	0
2016	1.997.554	90	1.797.798	199.755	1.240.481	539.339	0	17.978	0
2017	2.152.220	90	1.936.998	215.222	1.336.529	581.099	0	19.370	0
2018	2.318.862	90	2.086.976	231.886	1.440.013	626.093	0	20.870	0
2019	2.498.406	90	2.248.566	249.841	1.551.510	674.570	0	22.486	0
2020	2.691.853	90	2.422.667	269.185	1.671.641	726.800	0	24.227	0

Source: Author’s own compilation

Targets

Waste prevention policies have been introduced only recently at EU level and in most EU Member States. Effects of these polices remain yet to be observed on the quantity of waste generated. We therefore propose not to take waste prevention effects into account for the ENPI countries, which means that the target for waste generation is equal to the baseline. For this reason benefits like reduction of resource depletion will not be tackled directly (by reducing the consumption of resources), but in the context of recycling.

- 100% reduction in illegal dumping / disposal to landfills with no environmental control
- 50% recycling of all generated glass, paper, plastic, metals in municipal waste
- 70% recycling of construction and demolition waste
- 65% of the quantity of biodegradable waste generated in 2010 diverted from landfills

There are two kinds of EU targets :

- The recycling targets really look at a target year and request that 50% of a certain waste material generated in the target year is recycled in this target year.
- However, the EU landfill diversion target is much more permissive. In the EU the total amount of biodegradable waste landfilled in the years 2006, 2009, 2016 (or 2010, 2013, 2020) may not be above 65%, 50%, 35% of the total amount of biodegradable waste generated in 1995. We kept this philosophy and requested in this target that the amounts landfilled in ENPI countries in 2030 would not be higher that 35% of the amount of biodegradable waste generated in 2010. Of course, just as in the EU target, an increase of total waste generation is not taken into account, as the target refers to an absolute, ‘historic’ value and not to a relative percentage.

The horizon of reaching these ambitious targets is set at 2030. The calculated results will show the progress reached in 2020, on which the benefits are calculated.

In the first step, the target values in 2030 are calculated for recycling of paper, glass, plastic and metals, as well as for the diversion of biodegradable waste (Table 5-8).

Table 5-8 Target values in quantitative data for 2030

collection coverage:					
90	% population covered by municipal waste collection in 2008				
100	% population covered by municipal waste collection in 2030			(target year = 2030, year of scope = 2020)	
0,48	% yearly increase				
50% recycling of glass		50% recycling of plastic		minimum quantity for recycling in 2030	
510.712	generation in 2030	737.695	generation in 2030	1.220.034	tonnes
255.356	recycling target in 2030	368.847	recycling target in 2030		
50% recycling of paper		50% recycling of metals			
907.932	generation in 2030	283.729	generation in 2030		
453.966	recycling target in 2030	141.864	recycling target in 2030		
70% recycling of C&D waste					
no data	generation in 2030				
no data	recycling target in 2030				
65% landfill diversion of biodegradable waste				maximally allowed on landfills in 2030	
1.095.566	generation in 2010 (previous tab)			4.962.459	tonnes
712.118	not allowed on landfills in 2030				

In the second step, a scenario is developed in which the targets have been reached in 2030, and in which the appropriate distance to target has been bridged in 2020.

If in 2030 69% of the generated waste would be landfilled, 22 % would be recycled and 9% would be composted, the targets will have been reached (see Table 5-9).

Table 5-9 Minimal percentages for different waste treatment options in a scenario in which target values for 2030 have been reached

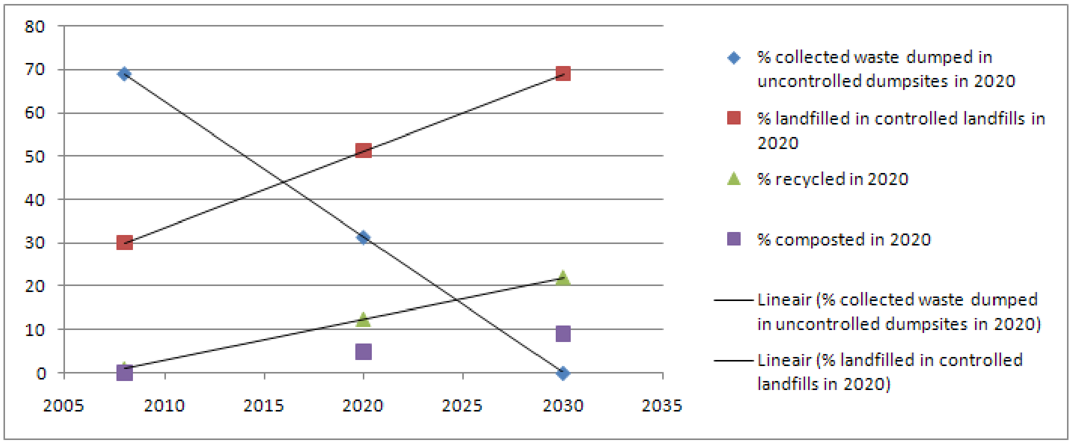
		calculated value	target value		distance to target	evaluation
0	% collected waste dumped in uncontrolled dumpsites in 2030					
69	% landfilled in controlled landfills in 2030	3.915.458	4.962.459	(max)	-1.047.001	target reached
0	% incinerated in 2030	0				
22	% recycled in 2030	1.248.407	1.220.034	(min)	-28.373	target reached
9	% composted in 2030	510.712	258.152	(min)	-252.560	target reached

Assuming a linear progression to these targets in 2020, the following waste treatment options have to be reached (see Table 5-10 and Figure 5-1):

Table 5-10 Minimal percentages for different waste treatment options in 2020 if targets have to be met in 2030

31,4	% collected waste dumped in uncontrolled dumpsites in 2020
51,3	% landfilled in controlled landfills in 2020
0,0	% incinerated in 2020
12,5	% recycled in 2020
4,9	% composted in 2020

Figure 5-1 Evolution of waste treatment options in order to reach targets



Environmental Improvements

The environmental improvements are comprised of two sections: the amount of waste not being dumped in uncontrolled dumpsites, and the amount of waste supplementary recycled and composted. Improvements are calculated as the difference between the target compliance scenario and the baseline scenario (Table 5-11).

Table 5-11 Environmental improvements in 2020

the amount of waste not being dumped in uncontrolled dumpsites			
	amount dumped in the baseline scenario :	1.940.826	tonnes
	amount dumped in the target compliant scenaric	930.661	tonnes
	difference = environmental benefit	1.010.165	tonnes
the amount of waste supplementary composted or recycled			
	amount in the baseline scenario :	24.227	tonnes
	amount in the target compliant scenario	445.547	tonnes
	difference = environmental benefit	421.320	tonnes

5.3.3 Qualitative assessment of the benefits of improving waste treatment

<table>
<tr><td>Health benefits</td><td>- Diverting waste from uncontrolled dumpsites to sanitary landfills introduces a number of health benefits, such as reduced air pollution from dumpsites, particularly when these dumpsites catch fire and toxic and carcinogenic gases are released. The expansion of urban areas in the Palestinian territories is increasing residents' exposure to air pollution from open dumpsites, and thus diverting random dumpsites to centralized landfills located far away from densely populated areas will introduce higher health benefits over time (this has already been recognized in Gaza, where three landfills already serve a relatively large portion of the population).
- In addition, landfills will decrease leachate dripping, soil contamination and pollution of groundwater, which eventually find their way into the water taps of Palestinian communities, particularly in the west bank where water supply is often decentralized and relies heavily on local aquifers.
- Finally, landfills will reduce population exposure to of insect-borne and animal-borne (e.g. rodents) diseases, which are induced from residents' proximity to open uncontrolled dumpsites.</td></tr>
<tr><td>Environmental benefits</td><td>- Improving waste management practices (landfilling, recycling) can reduce can the number of illegal dumpsites in the Palestinian Authority, currently assessed at some 450 sites. Neither the location nor the set of these sites meets the minimal environmental standards, and they can cause long-term air pollution (over several decades) and irreversible damage to local aquifers.
- In addition, composting biodegradable waste can reduce methane emissions from landfills, a greenhouse gas with a much higher global warming potential compared to CO_2 (by a factor of 21).
- Reducing the volume of waste through recycling and composting (as well as through efficient landfilling) will also decrease land-use for waste disposal (and the associated environmental degradation), a scarce resource in some parts of the Palestinian territories, particularly the Gaza strip.</td></tr>
<tr><td>Economic benefits</td><td>- Several economic benefits can be derived from the above environmental improvements. First of all, recycled materials and composted organic waste can be used as secondary raw materials, either for Palestinian industry or exported to foreign industries. For example, composted organic waste can be used for agriculture, one of the most dominant sectors a major component of the economy's GDP.
- Secondly, the reduced health impacts mention above will lead to indirect economic benefits, such as reduced morbidity and mortality due to improved air and water quality, which is a particular concern in densely populated areas, such as Ramallah city or in the Gaza strip.</td></tr>
<tr><td>Social benefits</td><td>- Several social benefits can also be derived from the above environmental improvements. To begin with, landfill construction and maintenance, as well as the upscale of the recycling industry, will lead to job creation. As was assessed in the quantitative assessment below, 350 jobs can be created from the above mentioned environmental improvements.
- In addition, closure of open dumpsites nearby residential areas will improve the quality of life for the Palestinian population, and will reduce its vulnerability to health related impacts. In particular, it will reduce the vulnerability of poor children which are sent to scavenge the dumpsites in search for recyclable materials which can be sold at the market.</td></tr>
</table>

	- Finally, improving waste management practices offers an opportunity to strengthen existing public institutions, for example in collection of waste fees and landfills levies. This can lead to capacity building at the local and national level, which can spill over to other policy domains (e.g. water, land-use, etc) and it was mentioned as one of the targets of the National Strategy for Solid Waste Management in the Palestinian Territory 2011-2014 (Palestinian National Authority, 2010).

5.3.4 Quantitative assessment of the benefits of improving waste treatment

The number of employees needed for shifted waste treatment options is assessed as follows:

- An average landfill with a capacity up to 1,000,000 tonnes requires 1 chief, 4 porters, 1 compactor driver, 1 bulldozer driver, 1 excavator driver, 1 driver, 1 pump operator, 1 maintenance technician, 1 weighing pond operator = 12 jobs
- The number of employees for a straightforward windrow composting plant of 20,000 tonnes/year = 5 jobs
- Job potential in the recycling industry is very diverse, and an average is not estimated. A conservative assumption is that it will not require less employees to recycle than to landfill.

When applying these assumptions on the amounts of waste treated in a way diverging from the baseline scenario, following amounts of job creation can be assessed (Table 5-12):

Table 5-12 Assessment of job creation in 2020 when evolving towards target values in 2030

average number of employees to serve a landfill with 1.000.000 tonnes capacity or 50.000 tonnes yearly capacity	12
amount landfilled in the baseline scenario :	726.800
amount landfilled in the target compliant scenario :	1.315.645
supplementary yearly capacity	588.845
supplementary jobs	141
average number of employees to yearly recycle 50,000 tonnes	12
(conservative estimate : recycling generates no less jobs than landfilling)	
amount recycled in the baseline scenario	24.227
amount recycled in the target compliant scenario	319.581
supplementary yearly capacity	295.354
supplementary jobs	71
average number of employees to yearly incinerate 50,000 tonnes	24
(conservative estimate : incineration generates 2* jobs than landfilling)	
amount incinerated in the baseline scenario	0
amount incinerated in the target compliant scenario	0
supplementary yearly capacity	0
supplementary jobs	0
average number of employees to yearly compost 20.000 tonnes	5
amount composted in the baseline scenario	0
amount composted in the target compliant scenario	125.966
supplementary yearly capacity	125.966
supplementary jobs	31
Job balance	
supplementary jobs	244

Source: Authors' own compilation

5.3.5 Monetary assessment of the benefits of improving waste treatment

This study has not attempted to monetize the benefits of improving waste management due to the complexity of the task and the budgetary constraints of the project.

5.4 Benefits from reducing methane emissions from waste

When biodegradable waste is landfilled or dumped, anaerobic conditions may occur in which the waste starts to decompose by bacterial activity, generating among other methane emissions. These greenhouse gasses contribute to global warming: methane is a greenhouse gas with a much higher global warming potential than CO_2, with a global warming factor of 25 tonnes of CO_2-equivalent per tonne of methane). Socio-economic benefits are associated with the reduced global warming impact of the avoided methane emissions, reduced environmental and nuisance impacts and the use of the landfill gas as an energy resource – methane emitted from landfills is essentially the same chemical substance as natural gas. Methane emissions from landfills can be captured and either flared (burned on site to reduce the global warming impact of methane to that of CO_2), or stored for use as a fuel.

The landfill gas emissions in the baseline scenario and in the target compliant scenario in 2020 are derived from an assessment of the total amount of waste landfilled, dumped or not collected. In the target scenario we supplementary assume that 20% of all landfills are equipped with landfill gas collection systems. The difference between both shows the amount of landfill gas emissions that supplementary can be avoided. The socio-economic benefits can be expressed in the marked values of avoided CO2eq.

5.4.1 Current level of methane emission from waste

Biodegradable waste that produces methane, particularly organic waste, makes up a significant portion of MSW in the occupied Palestinian territory. Some 60% of all Municipal Solid Waste and about 80% of Residential Solid Waste is organic, which is the main source of methane emissions (Al-Khatib & Arafat, 2010). Hence, the high content of organic waste creates a great potential for reducing volume through composting and for energy production through incineration.

However, to date, composting has not been implemented to a significant degree at the national level in the Palestinian authority. Pilot composting programs were started in conjunction with the landfill system in the Gaza strip, but they have been halted due to damage caused to the facilities by IDF attacks and due to the danger posed to the workers at the facilities. Other barriers for implementation include resistance at the local level for constructing composting facilities nearby residential areas, which has halted, for example, the construction of an NGO-based pilot composting project near Bethlehem (ARIJ, 2007, S. 129).

No data was found regarding composting of organic waste in the Palestinian Authority.

In addition, although several sanitary landfills have been constructed in the Palestinian territories, which currently treat some 30% of the waste, these are not equipped with methane capture systems (see section 4.3 on Waste Treatment above). Hence, for the purposes of this study, it is assumed that at the current state no methane emissions are captured from landfills.

5.4.2 Potential environmental improvements

Baseline scenario

The baseline scenario for methane emissions calculates methane emissions generated from landfills and dumps in 2020. The baseline scenario for landfilled MSW is based on section 4.3 Waste Treatment, which projects that 726,800 tonnes of MSW will be collected and landfilled in 2020, and 1,940,826 tonnes will be dumped. Using a methane genesis of 170

m^3/tonne of waste, results in 453.5 million cubic metres of methane emissions from MSW in 2020 (Table 5-13). See Annex 1 for explanations on methane genesis from landfills.

Table 5-13 Methane emissions from municipal solid waste in the baseline scenario, 2020

total amount not collected municipal waste in 2020 in the baseline :	269.185	tonnes
total amount collected municipal waste in 2020 dumped in the baseline :	1.671.641	tonnes
total amount collected municipal waste in 2020 landfilled in the baseline :	726.800	tonnes
sum	2.667.626	tonnes
methane genesis	170	m^3/tonne
methane generation for waste disposed of in 2020 :	453.496.427	m^3
methane capture in 2020 :	0	m^3
methane emissions for waste disposed in 2020 :	453.496.427	m^3

In addition, the baseline scenario also calculates the captured and avoided methane emissions, through two methods: captured methane emissions in landfills and avoided methane emissions through composting. Assuming that the current state of the environment continues throughout 2020, zero methane emissions will be captured or avoided in 2020 (see Table 5-14 below).

Table 5-14 Reduced methane emissions in Baseline scenario in 2020

tonnes	MSW generated	MSW collected	MSW landfilled or dumped	Methane generated from landfilled MSW (m^3)	Methane emissions captured in landfills	Organic MSW diverted from landfills (composted)	Methane reduced by diverting organic waste from landfills
Baseline	2,691,853	2,422,667	2,667,626	453,496,427	0	0	0

Source: Author's own compilation

Targets

Two targets are defined for methane capture:

1. **Composting of organic waste diverted from landfills:** This target is derived from the previous section (4.3. waste treatment), and was defined as 9% of total waste generation by 2030 or 4,9% by 2020.
2. **Target for methane capture in landfills:** 20% of methane from landfills will be captured with methane capture systems.[24]

Environmental Improvements

In line with the targets mentioned above, methane emissions will be reduced in two ways: methane capture in landfills and the composting of organic waste diverted from landfills.

In the first case, we assume that 20% of methane at landfills will be captured due to the equipment with methane capture systems in 2020. This corresponds to capture of

24 This was based on the assumption that half of the newly constructed landfills will be equipped with methane capture systems, and these account for about 20% of the total land-filling capacity.

76,374,409 m³ of methane emissions (see Table 5-15). Furthermore, decreasing amounts of waste being landfilled or dumped have to be taken into account. We assume that recycling of e.g. wood or paper fractions will not cause methane or CO_2 emissions, which is not entirely true.

Table 5-15 Methane emissions from municipal solid waste in target compliance scenario, 2020

total amount not collected municipal waste in 2020 in the target :	125.878	tonnes
total amount collected municipal waste in 2020 dumped in the target :	804.783	tonnes
total amount collected municipal waste in 2020 landfilled in the target :	1.315.645	tonnes
sum	2.246.306	tonnes
methane genesis	170	m³/tonne
methane generation for waste disposed of in 2020 :	381.872.043	m³
20% methane capture in 2020 :	76.374.409	m³
methane emissions for waste disposed in 2020 :	305.497.634	m³

In the second case, we assume that 4,9% of the organic waste diverted from landfills will be composted in 2020, and that composting reduces methane generation by 90% compared to landfilling, as composting also generates some methane, but in a much lower proportion than landfilled waste. Assuming 125,966 tonnes of waste will be composted in 2020 (see previous section on waste treatment), this is equivalent to 2.141.423 m³ of still non-avoided methane emissions (see Table 5-16).

Table 5-16 Reduced methane emissions in Baseline and Target compliance scenarios in 2020

	MSW generated (tonnes)	Methane generated from landfilled or dumped MSW (m³) – taking into account methane capture	Methane generated from composting biowaste diverted from landfills (m³)
Baseline	2.691.853	453,496,427	0
Target	2.691.853	305,497,634	2,141,423
Avoided methane emission		147,998,793	-2,141,423
Total benefit		145,857,370	

Source: Author's own compilation

The two processes combined will lead to a reduction of 145,857,370 m³ of methane emissions.

5.4.3 Qualitative assessment of the benefits of reducing methane emissions from waste

Currently, there are several available technologies to capture methane gas from biodegradable waste (biomass) or to produce energy from the incineration of biodegradable waste. This can reduce emissions which otherwise would have been emitted to the atmosphere, and help to reduce dependency on fossil fuels for energy production. This can provide an opportunity for increasing energy independence for the Palestinian Authority, as well as reducing expenditures on energy. Currently, the Palestinian Authority is entirely dependent on Israel for energy imports (fuel and electricity), at constantly rising prices. Hence, developing independent energy sources from renewable sources such as biogas from waste offers a number of strategic and economic benefits for the oPt.

5.4.4 Quantitative assessment of the benefits of reducing methane emissions from waste

The above mentioned environmental improvements will lead to a reduction of 145,857,370 m³ of methane emissions. Methane has a global warming potential much stronger than CO_2 (by a factor of 21), and thus these methane emissions are equivalent to **2.08 million tonnes of CO_2 eq**.

Currently, the Palestinian Authority is not a signatory to the Kyoto Protocol and thus cannot participate in carbon trading schemes such as CDM. However, to the extent that this will be a possibility in the future, the Palestinian Authority could realise revenue from implementing projects for reducing methane emissions, which can be sold as carbon credits to developed countries (see monetary assessment below).

5.4.5 Monetary assessment of the benefits of reducing methane emissions from waste

The social and economic benefits are linked with the value of avoided CO_2 eq. emissions and the effect of global warming. Assuming a value per avoided ton of CO_2 emissions ranging from 20€/tCO_2 (lower bound) to 39€/tCO_2 (medium estimate) to 56€/tCO_2 (upper bound) for 2020, the avoided emission of 2.08 million tonnes CO_2 eq corresponds to a benefit of **EUR 41.7 million to 116.6 million, with a medium estimate of 81.2 million Euro.**

6 BENEFITS OF IMPROVING NATURE RELATED CONDITIONS

The occupied Palestinian territory is located in a unique position between different bio-geographic regions: the European, Asian and African continents, the Mediterranean and the Red Sea. The territories are divided into five agro-ecological zones (the Jordan Valley, the Eastern Slopes, the Central Highlands the Semi-coastal Plain, and the Coastal Plain) which are all vastly different in climate. As a result of this distinctive situation, the region has considerably high biodiversity. The natural ecosystems of the area are exceptionally important because of their unique intrinsic value, their stabilizing effect on the environment, and direct support for human activities such as agriculture, animal husbandry, forestry, traditional and pharmaceutical health products, tourism, and many others (Sabeel 2007, ARIJ 2007).

There are about 51,000 living species in the occupied Palestinian territory, constituting approximately 3% of global biodiversity. There are an estimated 30,904 animal species, consisting of 30,000 invertebrates, 427 birds, 297 fish, 92 mammals, 81 reptiles and 7 amphibians. Palestine is a particularly important location for birds because it is the home for approximately 427 species year-round and also a critical resting point for 274 species of migratory birds during the migration season. The country also hosts 2,750 species of plants from 138 families, including 149 endemic plants that do not exist in any other part of the world. As a historic centre of crop diversity and cultivation, Palestine is the birthplace of many essential crops such as wheat, barley, vines, olives, onions, and pulses (Environmental Quality Authority 2006, ARIJ 2007). The sustainability of agricultural production is inextricably tied to the status of a diverse natural biota and environmental balance.

Over time the Palestinian environment has suffered considerable degradation. Both the Israeli occupation activities and Israeli settlers and the Palestinian population, due to the high population growth rate, impose high pressure on the fragile ecosystem of the occupied Territories. Natural ecosystems have been, and continue to be, destroyed to make way for agricultural, industrial, or housing developments. A number of pressures therefore affect natural habitats in Palestine: unplanned urban expansion, overgrazing, over-exploitation, deforestation and unplanned forestry activities, desertification and drought, soil erosion, hunting, invasive alien species, pollution, and contamination.

The Israeli Occupation exacerbates these problems, as it limits the Palestinian Authority's ability to regulate land use, to properly monitor the status of the environment and to enforce environmental protection measures. In addition, there is also a direct impact of the Israeli occupation on natural resources, adding to the existing pressures. Direct impacts of the occupation include the building of settlements, bypass roads and military outposts, the destruction of infrastructure and seizure of agricultural land, including deforestation of forested areas. A particular pressure arises from the construction of the segregation wall. The fragmentation of the landscape and natural ecological corridors because of the wall has proven to disrupt migration patterns and genetic contiguity, therefore threatening the viability of populations (Sabeel 2007). All of these practices have resulted in extensive land fragmentation and added to the destruction of ecosystems. Seizures of agricultural land also result in overgrazing of the remaining area accessible to the Palestinian livestock herders. Overgrazing has resulted in the loss of the vegetation cover, soil erosion, intensive desertification, and caused changes in the topography and natural stream flow routings (EQA 2006, ARIJ 2007).

Taken together, the effect of these pressures has been to diminish the presence of commonly found wildlife in the area, which includes mammals such as wolves, coyotes, foxes, and hyenas. Some animals, like the wild boar, have adapted to life in a more urban setting. During the last 30 years, 370 species in the oPt have changed their status to become rare or very rare. There are 22 animals facing the threat of extinction, including 5 mammals, 5 species of Herpetofauna, and 12 species of birds. Furthermore, 56 Mediterranean fish species are also officially threatened. In terms of plant species, out of the 2,076 recorded 636 are listed as endangered, 90 of which are identified as very rare (ARIJ 2007).

6.1 Benefits of improving biodiversity protection

Any assessment of the benefits of increasing the protection of biodiversity in the occupied Palestinian territory is limited by two constraints. First, data on the state of biodiversity in the region is incomplete, and in particular information on the extent and coverage of protected areas in the West Bank and Gaza is lacking. Second, the fact that biodiversity protection policies – and, in particular, the designation and upkeep of protected areas – is closely intertwined with the Israeli occupation and settlement policies. Palestine is globally known as the source for wheat and barley genetic resources in addition to other crops. Loss of such genetic resources is invaluable.

There are 48 nature reserves in the West Bank, which have been designated by the Israeli military order. They cover a total of 579 km^2, about 9.6% of the land area of the occupied Palestinian territory. The largest nature reserve is on the riparian areas of the Dead Sea in the Bethlehem governorate, and accounts for more than a fifth of the protected area alone (ARIJ 2005). Most of the existing nature reserve in the West Bank belong to the Area C, which means they are fully controlled by the Israeli civil administration. Only 13 reserves (or 11.3 % of the total reserve area) are within the Area B and are therefore in principle under Palestinian control, unless Israel restricts Palestinian access to Area B. This means that the Palestinian management agency, currently the Ministry of Agriculture, cannot access most of the protected areas on the West Bank for management purposes – although enforcement activities in some reserves may be possible (UNEP GRID 2002). There are no Israeli-designated nature reserves in the Gaza strip, but the Palestinian Authority established the Wadi Gaza nature reserve in June 2000. Due to the lack of access and proper management of the protected areas, there is hardly any information on the composition and richness of species found in the protected areas; neither is there any organised educational or touristic exploitation of the nature reserves. Partly as a result, there are no studies that have discussed – let alone quantified – the economic value of protected areas in the West Bank and Gaza.

A problematic aspect concerns the linkage between nature reserves and Israeli settlement policies. ARIJ (2005) lists 16 incidences, where in the past parts of nature reserves have been converted to make room for Israeli settlements or military bases. Consequently, there is widespread mistrust that the designation of areas as natural or historical heritage is another means of land confiscation for Israeli settlements.

Due to the lack of data and the difficult political constellation, the benefits of improving biodiversity protection could not be quantified in this study.

Figure 6-1 Nature Reserves in the oPt

Source: Ministry of Planning, 2011

6.2 Benefits from forests and reducing deforestation

The benefits assessment on this subtheme on deforestation looks at the benefits of avoided deforestation (where applicable), which have to be seen in the contract of the current forest cover and benefits, and the trend in loss/gain of forest coverage.

In 1999, the Ministry of Agriculture reported 23,159 hectares of forested areas in the West Bank and Gaza. Almost all of these forests are found in the West Bank, where 93 major forests cover 22,959 hectares, about 4% of the land area in the West Bank. The Gaza strip, by contrast, has 13 forests covering some 200 ha or 0.5% of the land area, all of which are planted forests (MOA 1999 cited in ARIJ 2006a, p. 4). For all of the West Bank and Gaza, about one fifth of the forests are planted forests, the huge majority (79%) being natural forest.

Forests are important for the conservation of species, habitats and genetic diversity, which have a value in their own right ('intrinsic values'), irrespective of the benefits that they provide to human populations. The forests in the West Bank and Gaza host a great diversity of flora and fauna and making them a key ecological resource. The forests are home to 60 species of natural trees and 90 bush species. Beyond their ecological functions, forests in fact provide multiple functions, including goods and services such as timber, food, fodder, medicines, provision of fresh water, soil protection, cultural heritage values and tourism opportunities – leading to significant environmental, health, social and economic benefits. For instance, Palestinian forests provide important services to the local economy – including non-timber forest products such as fruits, nuts, honey, wax, resins, dyes as well as timber and firewood for industry and heating of private homes (ARIJ 2006a, p. 1). Where they are accessible, forests also offer possibilities for recreation and relaxation by visitors, and act as a buffer and filter to air, water and noise pollution.

During the British mandate and the Jordanian administration of the West Bank, efforts at reforestation were implemented, with some 3,535 hectares of newly planted forest bringing the total forested area to some 30,000 hectares in 1971. Between 1971 and 1999, almost a quarter of this area was deforested, including virtually all forests in the Gaza strip. ARIJ attributes most of this deforestation to Israeli settlement policies, including construction of settlements, military installations and roads (ARIJ 2006a, p. 2, 6). By way of illustration, ARIJ 2006a (p. 23, quoting figures of the Ministry of Agriculture) reports that the Israeli Army has removed 300,000 trees alone between September 2000 and March 2001.

Forests play an important role in the global carbon cycle for their ability to absorb carbon dioxide and store carbon in biomass. While forests serve as a net carbon sink, deforestation and forest degradation can be a substantial source of greenhouse gas emissions. The issue of carbon storage (stock) and sequestration (flow) is gaining in global prominence which will lead to increasing market/payments for avoided carbon emissions from deforestation and forest degradation.

For carbon values, we focus on stock values, and note also the marginal value of avoiding potential losses – especially in those countries were deforestation is not currently an issue, but where it will be important to protect and well manage the existing forest in order not to loose its existing value. Overall, the carbon values are here estimated with a relatively simple procedure applicable to all countries, therefore it has not been possible to take into account local specificities and tailored assumptions. The figures provided should therefore be seen as a general illustration of the potential carbon value of forests, providing an order of magnitude rather than a precise estimate, and hopefully offering a useful starting point for future country-tailored analyses.

The following definitions apply:

- *Forest:* Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use. (FAO, 2010)
- *Other Wooded Land:* Land not classified as "Forest", spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds *in situ*; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use. (FAO, 2010)
- *Deforestation:* includes activities such as conversion of forest to agricultural land, conversion for urbanisation, illegal logging *etc.* Forest may also be degraded by fire, pests and storms which can lead to their eventual loss. When considering factors driving deforestation, the likelihood of these degradation factors increasing/decreasing should also be considered.

6.2.1 Current level of deforestation

About 4% of the West Bank and Gaza is forested (1999 data), or about 23,000 ha of a total land area of 602,000 ha. Deforestation is currently an issue in the occupied Territory. Between 1971 and 1999, it is estimated that some 24% of forest cover have been lost, i.e. around 6,900 of then 30,000 ha. More recent data, however, is not available. In the 1971 – 1999 period, around 250 ha of forests were lost each year on average, or 0.82% of the forested area.

Table 6-1 Trend in total net forest cover, 1971 and 1999 estimates

Year	**1971**	**2000**
Total net forest cover (ha)	30,074	23,159

Source: MOA 1999, cited in ARIJ 2006a

6.2.2 Potential environmental improvements

In order to assess the benefits related to forestry, an ideal 'no net loss by 2020' target was set. This ideal target calls for reducing the annual incremental reduction of the current deforestation rate to 0 per cent by 2020. The analysis therefore aims to identify the benefits that achieving this reduction can bring.

Deforestation in the West Bank and Gaza stands currently at 0.82% (1999 data). If deforestation continued at the rate observed in 1971 - 1999, in the 'business as usual' scenario the total amount of forest lost by 2020 would be 5,186 hectares, i.e. a decrease of 22.4% of the current forest size.

If the target of halting forest loss is met instead, a possible path would be for the rate of deforestation to gradually and continuously fall until it stops completely in 2020. Although some forest will be inevitably lost in the next decade, its size will decrease at a lower rate than the current one, i.e. at 0.2% per year, and finally stabilize in 2020.

In the oPt, this would imply that, under the target scenario, forest cover will decrease to 22,186 hectares and remain at this level as from 2020. This would represent a loss of about 4.2% of forest land by 2020, but will still result in the avoided loss of 18.2% of forest land if deforestation were to continue at the current level. Compared to the baseline scenario, this would save 4,213 hectares of forest in the next decade.

The impacts in terms of avoided carbon emissions, and the equivalent monetary values, are assessed in the next chapters.

6.2.3 Qualitative assessment of the benefits of reducing deforestation

Forests provide a wide range of ecosystem services. These include:

- Air quality – forests can filter out airborne pollutants and dust, but also reduce noise pollution e.g. from traffic.
- Climate – forests regulate the local micro-climate, and act as a sink for carbon dioxide: they capture carbon dioxide from the ambient air and, through the process of photosynthesis, bind the CO_2 in the form of organic material (wood and leaves).
- Soil – forests conserve soil against wind and water erosion through the fixation by tree roots. Especially on slopes, deforestiaton is therefore often immediately followed by erosion. Forests can prevent further desertification or even reclaim areas where the process of desertification is underway.
- Water – forests purify rainwater and retain waterborne pollutants. They also act as a buffer, reducing run-off and evaporation of rainwater.
- Landscape – forests provide landscape and amenity values, all the more in an otherwise arid environment.
- Biodiversity – forests are an important habitat not only for trees and other plants, but also for a wide range of birds, mammals and other species.
- Social effects – forests provide important scenic and landscape values, and are often iconic nature areas. Through enjoyment of nature and landscape, they provide amenity and a "sense of place", and give opportunities for relaxation and recreation, including sports and leisure activities.
- Health effects – forests deliver cleaner, oxygen-rich air and a more moderate microclimate.
- Supply of timber and other forest products (including herbs, edible roots, mushrooms, honey etc.).

While all of these ecosystem goods and services are examples of obvious benefits that forests provide, and that are enjoyed by numerous visitors, only few of these goods and services are traded on markets. For instance, there are markets (and hence a price) for the timber provided by a forest or the honey that bees produce, but there is no market (and hence no market price) for the relaxation and amenity that a forest provides to visitors, or the pollination of plants by bees. For this reason, quantification of these benefits can be difficult, and where it is done, it often applies only to specific forest areas. The following sections quantify the carbon sequestration function of forests in the West Bank and Gaza.

6.2.4 Quantitative assessment of the benefits of reducing deforestation

Environmental benefits

Forests, like many other ecosystems are affected by climate change, both negatively and positively. Forests also have the ability to affect global climate and climate change. This effect can be due to increased reflection of heat into the atmosphere in an area heavily forested, than other types of land use that are more open and soil covered. Another effect can be due to forest's role in the global carbon cycle that affects global climate change. Forests absorb carbon in wood, leaves and soil (carbon sinks) and release it into the atmosphere when burned, during forest fires or the clearing of forested land (Source of Carbon emissions).

According to the FAO 2010 report, the world's forests store more than 650 billion tonnes of carbon, 44 percent in the biomass, 11 percent in dead wood and litter, and 45 percent in the soil. However, for this assessment we limit ourselves to what is stored in biomass.

Further to this The Economics of Ecosystems and Biodiversity (TEEB) shows that to halt forest degradation and deforestation is an integral part of both climate change mitigation and adaption when focusing on 'green carbon'. Forests are further useful to preserve due to their huge range of services and goods they provide to local people and the wider community (TEEB, 2011).

According to 2000 estimates, each hectare of forest stores on average 4725 tonnes of carbon, i.e. 172.34 tonnes of CO_2 (FAO, 2011a). Accordingly, in 1999 the forests in the West Bank and Gaza stored about four million metric tons of carbon in living forest biomass (see tables below). If deforestation were to continue at the current rate, about 0.89 million tonnes of CO_2 will be released due to the reduction in living forest biomass.

As noted above, meeting the ideal target of halting deforestation by 2020 will allow to save about 4,213 hectares of forest in the next decade compared to the business as usual scenario. This would correspond to a net saving of about 726,068 tonnes of CO_2 in living forest biomass.

25 We assumed that the average per hectare storage capacity has not changed throughout the years, hence assuming the 2000 carbon stock value remains valid today.

Table 6-2 Comparative assessment for CO_2 stored under BAU and target scenarios.

Year	1999	2020 – continued deforestation	2020 – deforestation halted	Net saving
CO_2 stored (tonnes)	3,991,222	3,097,467	3,823,535	726,068

Source: own calculations based on MOA 1999

Economic benefits

ARIJ (2006a) notes that the commercial significance of forests in the West Bank is limited: natural forests produce between 1 and 3.3 m^3 of wood per hectare for oak forests and around 4.3 m^3 per hectare for moderately dense Pine forests. Wood in natural forest grows at an annual rate of 0.2 m^3 per hectare, is much less than the threshold for commercial forests (1m^3 per hectare) (ARIJ 2006a, p. 18). There is little investment in afforestation, as other land uses (including agriculture) promise a higher return at less up-front investment.

6.2.5 Monetary assessment of the benefits of reducing deforestation

Environmental benefits

By using a monetary (high and low) value for carbon, as identified in recent studies, it is possible to monetise the value of the amount of carbon currently stored in the forests' living biomass, as assessed above.

Assuming a value of CO_2 of 17.2 €/ton (low) and 32 €/ton (high) in 2010, the value of the carbon currently stored by the forests in the occupied Palestinian territories ranges between EUR 68.6 and 127.7 million. This is the value of the carbon stored in the living biomass as of 1999 (most recent data).

If the theoretical target of halting deforestation by 2020 is met, and assuming a future carbon value ranging between 20€/ton (low), 39€/ton (medium) and 56€/ton (high), in 2020 the carbon stored will be worth between 76.5 and 214.1 million €.

Comparing the scenarios with and without deforestation, the net benefits of halting deforestation in 2020 will be equivalent to 14.6 million € at a low estimate for carbon value, and 40.6 million € at a high carbon value. These benefits relate to the total avoided deforestation over the 1999 to 2020 period.

This is summarised in the table below.

Table 6-3 Estimated value of carbon storage in 2010 and 2020 (high and low estimate)

	Value in 2010		**Value in 2020**			
			Unit value (€/ton)	**If deforestation not halted**	**If deforestation halted**	**Difference**
	Unit value (€/ton)	**Total value (m€)**	**Unit value (€/ton)**	**Total Value (m€)**	**Total value (m€)**	**Net value (m€)**
Low estimate	17.2	**68.6**	20	**61.9**	**76.5**	**14.6**
Medium estimate			39	**120.8**	**149.1**	**28.3**
High estimate	32	**127.7**	56	**173.5**	**214.1**	**40.6**

In addition to the above benefits, an earlier study by Breghiet and Qanam (1998) set out to assess both the use-values and non-use values of Palestinian Forests. For the direct use value, the study arrived at the following results (cited from Merlo and Croitoru 2005, p. 142).

Table 6-4 Values of Palestinian Forests

Valuation Method / Output	Quantity	Value ($US\$_{1998}$)	Value ($€_{2008}$)
Market price valuation			
Timber (m^3)	1,500	125,000	141,400
Firewood (m^3)	1,500	75,000	84,800
Seeds, stone fruits (t)	500	200,000	226,200
Medicinal plants (t)	700	245,000	277,000
Natural fruits (t)	300	90,000	101,800
Dyes and other colouring items (t)	50	15,000	17,000
Others	-	40,000	45,200
Substitute goods pricing			
Grazing (t of fodder)	5,040	504,000	570,000
Total direct use values		1,294,000	1,463,400

Source: Breghiet and Qanam 1998, cited in Merlo and Croitoru 2005, p. 142. Euro values converted to 2008 Euro based on harmonised historic inflation figures (HICP).

Wherever possible, direct use values were calculated on the basis of the available average market prices for and the product quantities commercialised each year. The resulting direct use value is relatively modest at 1.46 million Euro per annum. However, as the authors of the original study argue, the calculations are also constrained by considerable data restrictions, not least since some of the services listed above (e.g. grazing) are consumed for free and hence not measured or monitored; for other products, data is likely to be incomplete. As an expert guess, the authors argue that the total benefits could be six or seven times higher than the calculations above suggest, i.e. closer to US$ 9 million.

As ARIJ 2006a (p. 23) note, there are no statistics or other estimates, and no literature that has assessed option, bequest and existence values of Palestinian forests. While forests are open to local people for recreation, collection of timber wood, fruits, medicinal plants etc., there is no data on the number of visitors to the forests or the quantities used and extracted from the forest.

6.3 Benefits from improved croplands

6.3.1 Introduction

Agricultural cropland degradation is widespread in many countries. This section assesses the benefits of a reversal of cropland degradation or, in other words, an improvement in cropland quality. A target for improvement in cropland quality to be achieved by year 2020 is specified, direct and indirect benefits of cropland improvements are discussed in qualitative terms, and direct benefits in terms of increased value of crop production are quantified.

Definitions of key terms used in this section are:

- *Cropland:* Land used for cultivation of agricultural crops.
- *Area harvested:* Hectares of cropland multiplied by the number of harvests per year.
- *Crop yields:* Tons of crops harvested per hectare of area harvested.
- *Crop production:* Tons of crop harvested, i.e., area harvested multiplied by crop yield.
- *Cereals:* Mainly wheat, barley, maize, rice, oats, sorghum, rye and millet.
- *Other crops:* Fruits, vegetables, fibre crops, oil crops, pulses, roots and tubers, treenuts and other minor crops.
- *Cropland quality:* Here defined as those characteristics and properties of cropland that affect crop yield. Cropland quality is impaired by cropland degradation and potentially improved by improved cropland management.
- *Cropland degradation:* Inter-temporal changes in properties of cropland such as loss of top soil (from wind and/or water erosion), soil salinity, soil nutrient losses and other degraded physical or chemical properties of the soil.
- *Human induced degradation:* Degradation caused by human activities.
- *Improved cropland management:* Here defined as practices that reduce, prevent, or reverse cropland degradation and preserve or improve cropland quality with positive impacts on crop yield.

6.3.2 Current status

According to 2010 World Bank data, the share of agriculture in GDP in West Bank and Gaza was 5.8 percent in 2008 (World Bank, 2010). The area harvested was 180 thousand hectares in 2008. Cereals constituted 35 thousand hectares and other crops about 145 thousand hectares.26

Much of agricultural cropland in West Bank and Gaza suffers from degradation. But systematic and nationwide data are scarce. The Global Assessment of Soil Degradation (GLASOD) reports on degradation in most countries of the world, but not in West Bank and Gaza (FAO, 2000).27 GLASOD does, however, report on land degradation in the neighbouring countries of Israel, Jordan and Lebanon. The national territory of these countries is classified into five categories: land that is non-degraded, and land with light, moderate, severe and very severe degradation. Using an average of these three countries as an indication of land degradation in West Bank and Gaza suggests that 80 percent of the land area in West Bank and Gaza suffers from human induced degradation and that about 99 percent of the population of the country lives on or around degraded land (Table 6-5).

Table 6-5 Estimate of human-induced land degradation in West Bank and Gaza

Degradation	Land area degraded (% of national territory)	Population distribution
None	20%	1%
Light	35%	52%
Moderate	26%	18%
Severe	13%	28%
Very Severe	6%	2%

Source: Estimates by the authors based on land degradation in neighbouring countries of Israel, Jordan and Lebanon as reported in FAO (2000).

A disadvantage of the GLASOD data is that they date back more than 20 years. They may therefore represent an underestimate of land degradation today. Advantages of the data are that they provide a basis for multi-country economic assessments, and that economic assessments are simplified by the data providing land categories that reflect an aggregate of various forms of degradation.28 It is therefore not necessary to undertake an economic assessment of each type of soil degradation (erosion, salinity, nutrient losses, and other degraded chemical and physical properties of the soil).

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26 Area harvested is estimated based on linear trends using FAO reported data from 1996-2008 due to annual fluctuations in area harvested (FAO 2011).

27 GLASOD collated expert judgement of soil scientists to produce maps of human induced soil degradation. Using uniform guidelines, data were compiled on the status of soil degradation considering the type, extent, degree, rate and causes of degradation within physiographic units (Sonneveld and Dent, 2007).

28 Sonneveld and Dent (2007) note that the GLASOD data do not necessarily represent consistent classifications of land degradation across countries. Cross-country economic assessments are therefore not necessarily comparable.

6.3.3 Potential environmental improvements

Target to be reached by 2020

The target for which benefits are assessed in this study is an improvement in cropland quality by the year 2020, resulting in an increase in crop yields equivalent to half of the crop yield losses from current levels of land degradation. Improvement in land quality also has other benefits that are discussed below in qualitative terms.

It is assumed that the improvement in cropland quality as stipulated by the target is achievable through improved cropland management practices that reduce or halt on-farm loss of top soil from erosion, reduce soil salinity, partially of fully replenish soil nutrients, and improve other physical and chemical soil properties.

The GLASOD data are used here to estimate the increase in crop yields from meeting the target in 2020. Such estimation is, however, not free from problems and necessitates many assumptions:

- First, crop yield reductions resulting from current levels of land degradation must be assumed. Plausible reductions applied here are presented in table 2 using a “low”, “medium” and “high” scenario.29
- Second, the GLASOD data do not allow for crop specific yield effects. It is therefore assumed that all crops cultivated in each land category suffer from the same yield reduction.

In light of the need for these assumptions, the benefit assessment in this section should be considered as only indicative.

Table 6-6 Assumptions on crop yield reductions on degraded land

Land degradation categories	Yield reduction (relative to non-degraded land)		
	“Low	“Medium”	“High”
Not degraded	0%	0%	0%
Lightly degraded	5%	5%	5%
Moderately degraded	10%	15%	20%
Severely degraded	15%	20%	25%
Very severely degraded	20%	25%	30%

Source: Assumptions by the authors.

29 The assumed yield reductions for “moderately degraded” land are of similar orders of magnitude as average yield losses reported in Pimentel et al (1995) and a literature review of several regions of the world by Wiebe (2003).

Baseline to 2020

The baseline (in terms of tons of crop production) is projected to 2020 from the reference year 2008, assuming business-as-usual (i.e., no change in cropland management practices). This baseline crop production is then compared to the estimated crop production in the target scenario, which assumes better cropland management and therefore higher yields.

Projections in real crop prices to year 2020 must also be made in order to estimate the monetary benefit of improvement in cropland quality.30

Baseline assumptions are presented in Table 6-7.

Table 6-7 Projected baseline crop production and value of production, 2008 - 2020

	Cereals	Other crops
Annual increase in crop production	1.9%	0%
Annual increase in real crop prices	4.0%	3.0%

Source: Estimates by the authors.

The projected annual increase in crop production from 2008 to 2020 is based on linear trends in production of cereals and other crops in West Bank and Gaza from 1996 to 2008, using data from FAO (FAO 2011). The projected increase in production reflects increases in both changes in the areas harvested and crop yields.

Crop prices may be expected to increase at a faster rate to 2020 than prices of other goods and services in the economy. The FAO world food price index increased by 33 percent and the FAO world cereals price index increased by 31 percent from the 2007-2010 average index value to the January-February 2011 average index value (FAO 2011). However, the large price increases of cereals and foods observed during 2006-2008 and again in 2010 are likely to be offset by future periods of decline in prices as experienced during 1999-2003 and again in 2009. Thus the projected real price of cereals is assumed to increase at a rate of 4 percent per year and the real prices of other crops at a rate of 3 percent per year to 2020. The crop prices in reference year 2008, to which these increases are applied, are the international commodity prices for cereals and the producer prices in West Bank and Gaza for other crops, as reported by the FAO.31 International commodity prices for cereals were applied because they reflect the real economic value of internationally traded crops better than domestic producer prices.

Improvements achieved by reaching the targets

The improvement achieved by reaching the 2020 target is the difference between cropland quality with no change in cropland management practices and cropland quality with improved land management practices. This difference is assumed to result in an increase in crop yields equivalent to half of the crop yield losses from current levels of land degradation (*see Target to be reached by 2020*), i.e. improved management can avoid half of the damage

30 Real crop price increase is nominal crop price increase minus the nominal price increase of other goods and services in the economy.

31 Reference year cereal prices are averages for 2007-2010 to smooth the price volatility observed in 2008.

that is otherwise expected. Improvements in cropland management practices may also be expected to have other benefits that escape a monetary valuation (see below).

The GLASOD data do not map crop areas harvested by the categories of land degradation in Table 6-6. It is therefore necessary to make assumptions about the distribution of crop areas harvested. Two distribution options are used here:

1. Crop areas harvested are distributed in proportion to land area in each land degradation category (e.g., 13 percent of areas harvested in West Bank and Gaza are on severely degraded land, see Table 6-6).
2. Crop areas harvested are distributed in proportion to population distribution across the land degradation categories (e.g., 28 percent of areas harvested in West Bank and Gaza are on severely degraded land, see Table 6-6).

The first option assumes that crop area harvested is uniformly distributed across the country. This is highly unlikely because of uncultivable desert and arid areas. The second option assumes that hectares of crop area harvested per population are the same everywhere, i.e. harvested land areas follow the same pattern as population distribution. Likewise, this is also a rough approximation, given large shares of densely populated urban areas (e.g. in the Gaza strip) with little agriculture to speak of.

Table 6-8 presents estimates of yield increase from meeting the target in 2020 based on the two distributions of crop areas harvested. “Low”, “medium” and “high” refer to the scenarios of yield losses from land degradation in table 2.

Table 6-8 Estimates of yield increase from meeting the target in 2020

	Land area distribution	Population distribution	Mean value
Low	4.0%	4.9%	4.4%
Medium	5.3%	6.3%	5.8%
High	6.7%	7.9%	7.3%

Source: Estimates by the authors.

6.3.4 Qualitative assessment of the benefits of reaching the targets

Improvement in cropland management resulting in improved cropland quality and reversal of cropland degradation has many direct and indirect benefits, including health-related environmental, economic and social benefits. Direct benefits are those that accrue on-farm, such as increased crop yields and long-term sustainability of land use. Indirect benefits are those that accrue off-farm, such as benefits from reduced soil and agro-chemical run-offs. A generic overview of these benefits is provided in table 5 (e.g., see also CDE 2009).

Health benefits	– Soil erosion control can reduce agro-chemical run-offs which can help reduce pollution of water sources used for drinking and bathing, and thus contribute to protection of health. – Improved soil nutrient management can reduce the need for chemical fertilizer applications and thus reduce nitrate pollution of surface and groundwater resources used for drinking.
Environmental benefits	– Soil erosion control can reduce soil run-offs and sedimentation of rivers and lakes. Sediment: o causes turbidity in the water that limits light penetration and prohibits healthy plant growth on the river bed. o can cover much of a river bed with a blanket of silt that suffocates life. o is an important carrier of phosphorus, a critical pollutant which causes eutrofication. – Soil erosion control can reduce run-offs of agro-chemicals and thus reduce water pollution. – Improved land quality can prevent land becoming degraded to the extent that it is abandoned. Thus, in some countries, improved land quality can contribute to reduced desertification.
Economic benefits	– Improved land quality enhances agricultural crop yields. – Erosion control reduces sedimentation of reservoirs and dams used for irrigation, municipal water supply, and/or hydropower, and therefore increases their useful lifetime. – Reduced agro-chemical run-offs from erosion control may also reduce the cost of municipal water treatment.
Social benefits	Erosion control reduces agro-chemical run-offs and therefore improves quality of water bodies used for recreation.

Source: Produced by the authors.

6.3.5 Quantitative assessment

Many of the benefits of improved cropland management are difficult to quantify, such as health, environmental, and off-farm economic benefits. The quantitative assessment focuses therefore on the on-farm value of increased crop yields from improved cropland management. The economic benefits of reduced dam and reservoir sedimentation are especially important in water scarce counties. The social benefits of improved recreational values from reduced agro-chemical pollution of water resources are reflected in the benefit assessment section on surface water quality.

The benefits of meeting the target of improvement in land quality that reduces current crop yield effects of land degradation by 50 percent by 2020 are estimated based on the yield increases in Table 6-8. The yield increases are multiplied by the estimated value of crop production in 2020 (see below). This provide the estimated value of the extra tons of crop production as a result of reducing land degradation and are the annual benefits in 2020 of meeting the target.

6.3.6 Monetary assessment of the benefits

The projected real market value of total crop production in year 2020 is NIS 2,440 million. The annual benefits, i.e. the estimated value of the additional crop production in 2020 when the target is achieved, amount to 4-7 percent of this value, or NIS 108-178 million (PPP Euro 41-68 million). This is equivalent to 0.29-0.48 percent of projected GDP in 2020. All figures are in 2008 PPP Euro and 2008 NIS.

Table 6. Estimated annual benefits in 2020 of meeting the target

	Low	Medium	High
Value of increased crop yields (NIS million)	108	142	178
Value of increased crop yields (PPP EUR million)	41	54	68
Value of increased crop yields (% of GDP)	0.29%	0.38%	0.48%

Source: Estimates by the authors.
Note: Mean value of estimated yield increases in Table 6-8 is applied.

7 BENEFITS OF IMPROVING CLIMATE CHANGE RELATED CONDITIONS

7.1 Introduction to climate change related issues

Adapting to Climate Change

Like the rest of the world, the occupied Palestinian territory faces challenges derived from climate change. Agriculture and public health are expected to experience the most detrimental consequences due to the decrease in water resources. However, some of the expected adverse impacts of climate change can be softened through adaptation measures.

The consequences of climate change in the oPt can be predicted based on a combination of both biophysical and socio-political vulnerabilities, and the area most susceptible is undoubtedly water resources. In terms of biophysical vulnerability, the impact of climate change on water resources is expected to result in a significant decrease of annual precipitation. Annual precipitation rates are deemed likely to fall in the eastern Mediterranean, decreasing 10% by 2020 and 20% by 2050, with an increased risk of summer drought. These factors are going to add to the already existing problems with scarcity of freshwater resources in the oPt in both the West Bank and Gaza (Mimi, Mason, & Zeitoun, 2009).

The agricultural sector in the occupied Palestinian territory will be affected by seasonal temperature variability, a higher frequency of extreme weather events (storms, torrential rain and resulting floods), and a higher frequency of temperature extremes that may endanger cold and heat sensitive crops. The largest challenge for agriculture, however, is the anticipated decrease in water availability, the higher frequency of draughts and the increase in temperature. Agricultural livelihoods, particularly within rural rain-fed farming communities, are always directly affected by rainfall and drought incidence. The farmers in the oPt already experience difficulties when it comes to obtaining water because of the restrictions imposed by the occupation (Mimi u. a., 2009), resulting in an increase in farming production costs. As climate change continues, the current problems are expected to increase, increasing the oPt dependence on foreign aid.

In addition to the agricultural sector, public health will also be adversely affected by the predicted shortage of water availability due to the consequences of climate change. Since clean water is essential for nutrition and for sanitation and hygiene, the increasing water scarcity may result in an increase of health problems such as diarrhoea, cholera, and dehydration. The risk of parasitic disease may also increase with climate change because increased annual and seasonal variability, elevated mean temperature, and extreme weather events are all conducive to the spreading of existing vectors and establishment of new invasive ones (Mimi u. a., 2009). However, as of now, the occurrence of new vector-bourne diseases or the further spread of existing ones is not perceived as a major risk for public health.

Although public health and agricultural production in the occupied Palestinian territory face the most serious problems, the repercussions of climate change also extend to other sectors. Estimates of existing climate models predict that the mean sea level for the Mediterranean Sea may rise by 35cm by 2100, posing a serious threat to Gaza which imposes new challenges for coastal management (Mimi u. a., 2009).

Since awareness of the potential impacts of climate change is growing, the EQA and UNDP have developed the Climate Change Adaptation Strategy and Program of Action for the Palestinian Authority, which was prepared in a participatory approach involving all relevant stakeholders (Mason et al. 2010).

Climate Change mitigation

While the impacts of climate change and possible responses to them have been identified as a policy matter, there is still little attention for the mitigation of greenhouse gas emissions that cause climate change. This is also due to the particular situation of the Palestinian energy supply. In the oPt, energy consumption is increasing rapidly, reflecting the economic development and growth in population. The bulk of domestic and industrial energy consumption is in the form of electricity, with a demand of about 600 MW of the electrical power for the coming 10 years. This electricity is almost entirely (92%) imported from Israel (Yaseen, 2009): with only one oil-fuelled power plant in the Gaza strip and some decentralised, private diesel generators, the oPt has only little electricity generation capacity of its own. Consequently, the CO_2 emissions associated with this electricity production are entirely covered under the Israeli emission record. By contrast, the direct greenhouse gas emissions of the oPt are relatively modest, with CO_2 emissions stemming from the burning of petroleum fuels in transport and diesel generators, CO_2 emissions from land use change, emissions of nitrous oxide from agriculture, and methane emissions from waste disposal and agriculture.

In recent years, the Palestinian Energy Authority has expressed strong interest in climate change mitigation and clean energy, notably the anticipated role for increased renewable sources and greater energy efficiency in an independent Palestinian energy system. Currently, renewable energy sources already account for nearly 18% of final energy consumption in the occupied Palestinian territory, mainly through solar water heaters which are installed on more than 60% of the households in the oPt. Furthermore, several projects are underway to explore the potential of producing solar energy from centralized PV systems, as well as wind and geothermal energy (Yaseen, 2009). The main incentive for the oPt for investing in renewable energy systems is increasing its energy independency and reducing yearly expenditures on imported fossil fuels.

7.2 Benefits from increasing the uptake of renewable energy sources

7.2.1 Current uptake and potential for renewable energy sources[32]

In 2007, total primary energy supply in the oPt was 1,402 ktoe. The majority of this energy was imported from Israel (1,136 ktoe or 81%), either through the supply of electricity or through the supply of petroleum products (e.g. gasoline, diesel), which are both based on fossil fuels.33 The remaining 19% (266 ktoe) came from indigenous renewable energy sources, such as solar water heaters and biogas. Figures for primary energy supply and final energy consumption are presented in Table 7-1.

Table 7-1 Primary energy supply and final energy consumption in the oPt, 2007

Primary energy supply (ktoe)			
Imported energy		1,136	81%
there of:	electricity	266	19%
	petroleum products	869	62%
Indigenous energy sources (renewable)		266	19%
Total		**1,402**	100%
Final energy consumption (ktoe)			
Petroleum products		787	61.8%
Electricity		260	20.4%
Solar/Heat		105	8.2%
Biomass		121	9.5%
Total		**1,272**	100%

Source: (Yaseen, 2009)

[32] The analysis of the benefits of avoided CO_2 emissions from increasing the share of RES of the partner countries energy mix, focuses on total final energy consumption and builds on IEA data for these countries. Some assumptions as regards conversion losses in the electricity, heat and CHP (combined heat and power) were necessary in the calculations to allocate outputs to fuel inputs. The use of common assumptions for the countries has led to the renewable share of the total energy consumption being somewhat lower in the final RES figures ²than would be the case in practice, though not to the extent of changing the overall CO_2 savings significantly (the savings of meeting the ENPI wide target should arguably be a few percent lower on averages). This slight overestimate is thought to be more than offset by the arguably more conservative assumption that energy consumption per capita over the period 2010 to 2020 remains constant, as in reality future increase in demand can be expected to be more than offset by efficiency gains (hence the share of renewables over may be higher). Note that the Benefits Assessment Manual and the supporting spreadsheet tool available to countries have instead been revised using an adjustable set of conversion rates, to offer countries a tool that allows for using more country specific assumptions. Slightly revised values, taking into account some of these country-specific assumptions, have been included in the two regional ENPI synthesis reports, but not in the single country reports as these were already concluded before this additional finalisation of the method (conducted beyond the end of the project). Countries wishing to do their own analysis can explore the issue further by adapting their assumptions in light of fuller nuanced country-specific information on the electricity, heat and CHP stock (performance efficiency, losses, age), exports and imports of fuels, energy efficiency and demand changes.

33 In 2007, Israel produced almost all of its electricity from fossil fuels, mainly coal (Mor & Seroussi, 2007).

Consumption by sector

Most of the energy in the Palestinian Authority is consumed by the household sector, followed by transport (21%) and industry (7%). The household sector is also the largest consumer of electricity (61%), followed by commercial (22%) and industrial (9%) sectors (see Table 7-2). However, it should be mentioned that the household sector also accounts for the largest consumption of energy from renewable sources, as it is estimated that 61% of the households in the occupied Palestinian territory are equipped with Solar Water Heaters (SWH).34

Table 7-2 Energy and electricity consumption by source, 2007

Energy consumption by sector (ktoe)		
Households and other sectors	907	71.3%
Transport	276	21.7%
Industry	89	7%
Total	1,272	100%
Electricity consumption by sector (ktoe)		
Residential	158	61%
Commerical	57	22%
Industrial	23	9%
Others	21	8%
Total	260	100%

Source: (Yaseen, 2009)

Renewable Energy Sources (RES)

As shown in Table 7-1, final energy consumption from renewable sources accounts for some 226 ktoe, about 18% of total final energy consumption. This includes about 105 ktoe (8.2%) from solar energy and heat (geothermal), and about 121 ktoe (9.5%) from biogas. The former includes mainly energy produced by solar water heaters, which account for some 81 ktoe of energy consumption and which can be found in more than 60% of all households.

The potential for biogas production in the oPt is still being investigated, with only few demonstration projects in existence so far. One focus is small-scale biogas generation using animal dung, however the potential of this technology is still investigated (Yaseen, 2009).

Likewise, while there is a promising potential for the use of geothermal energy in the oPt as a source of energy for heating and cooling, experience so far is limited to pilot projects in the residential and commercial sector. The largest system was implemented in Ramallah in the headquarters of the Union Construction and Investment Corporation. This system has a cooling load capacity of 260kW and a heating load capacity of 230kW. It is expected to yield savings of about EUR 22,609/ year (30,000$/year) from reduced electricity consumption. Another small system has been installed in a residential district Etihad in Ramallah.

34 According to a survey conducted by the Palestinian Central Bureau of Statistics in 2010: http://www.pcbs.gov.ps/Portals/_pcbs/PressRelease/House_En12010E.pdf

In addition, photovoltaic (PV) electricity is slowly developing in the oPt, and total capacity is assessed at 50kWp. Wind energy is currently not produced in the oPt, but a number of projects are underway.

Greenhouse gas emissions

Table 7-3 presents total greenhouse gas emissions per sector for three greenhouse gases, according to a study conducted by ARIJ (2007). According to this study, in 1999 greenhouse gas emissions in the West bank totalled some 3.1 million tonnes of $CO_{2\text{-}eq}$. The majority of greenhouse gas emissions came from decomposition of solid waste (about 1.3 million tons of $CO_{2\text{-}eq}$), agriculture (about 675 thousand tons of $CO_{2\text{-}eq}$), from transportation (552 thousand tons).

Table 7-3 Total emissions (tons) according to source of pollution in the West Bank in 1999

	CO2 (tons)	CH4 (tons of CO2eq)	N2O (tons of CO2eq)	**Total (tons of CO2eq)**	**Percentage of total**
Economic sector	161,270		1,240	**162,510**	**5%**
Transportation	532,973		19,530	**552,503**	**18%**
Electrical Generation	108,053		930	**108,983**	**3%**
Fuel Burning	348,742		3,100	**351,842**	**11%**
Agriculture	3,686	1,302	670,530	**675,518**	**21%**
Solid Waste	266,745	1,026,963		**1,293,708**	**41%**
Total	1,421,469	1,028,265	695,330	**3,145,064**	**100%**

Source: ARIJ, 2007

Greenhouse gas emissions per capita

In 1999 Palestinian population was about 3,054 million. Thus, per capita emissions in the respective year were about **1.3 tons of GHG per capita**, which is a rather low figure, even for a developing country.

7.2.2 Potential environmental improvements

Baseline scenario

Table 7-4 presents two baseline scenarios for final energy consumption in the oPt in 2020, taking into account population and GDP growth. The upper row presents a scenario where energy per capita remains constant throughout 2020, and the bottom row presents a scenario where energy per capita increases in line with GDP growth (4.9% annual). This results in estimation for gross final energy consumption in 2020 ranging from 1,762-3,282 ktoe.

For both scenarios, we assumed that the share of RES and fossil fuels in final energy consumption will remain the same (i.e. 18% and 82% respectively). Assuming business as usual, this also means that the oPt will continue to import about 82% of its energy from Israel, albeit at a higher costs (due to the projected increase in the price of fossil fuels on the global market).

Table 7-4 Two baseline scenarios for gross final energy consumption in 2020

Total final energy consumption 2007	Population 20007	Final energy consumption per capita 2007	Estimated final energy consumption per capita in 2020[35]	Population in 2020	**Estimated final energy consumption in 2020**	Baseline Gross final energy consumption from RES in 2020	Share of RES over total in 2020	**Baseline final energy consumption from fossil fuels in 2020**
Ktoe	million	ktoe/million	ktoe/million	million	**ktoe**	ktoe		**ktoe**
1,272	3.937	323	323	5.454	**1,762**	313	17.74%	**1,449**
1,272	3.937	323	602	5.454	**3,282**	582	17.74%	**2,700**

Note: upper row assumes constant energy per capita, bottom row assumes an increase in energy per capita. Source: Author's own compilation

Target

The Palestinian Energy Authority, in partnership with the Palestinian Energy and Environment Research Centre, has formulated a National Plan for developing renewable energy and increasing energy efficiency in the oPt for 2007-2012. The target of this plan is to increase the share of RES to 20% of final energy consumption by 2012. This will be done through increasing utilization of solar energy by 8.5% (in buildings and industry) and by utilizing solid waste for energy generation (Yaseen, 2009).

Hence, renewable energy target for the occupied Palestinian territory can range between 25%-30% share of RES by 2020, the former representing a rather linear progression from 2012 and the latter a more ambitious path for RES.36 The oPt's strong interest in increasing its energy independency and reducing expenditures on imported fuels would suggest a more ambitious scenario. Furthermore, RES potential in the oPt is high. For example, the additional installation of Solar Water Heaters in the residential and service sectors has an energy potential of 940 GWh (Yaseen, 2009). In addition, biogas potential in the oPt amounts to some 33 million m^3 (Ibid). Hence, SWH and biogas alone have an energy potential of about 113 ktoe, which – if implemented – would account for 6.4% of total energy consumption in 2020 (see Table 7-4 above, upper row).

35 We assumed energy consumption per capita will grow in line with GDP, and that 4.9% annual growth in GDP will result in 4.9% annual growth in energy consumption per capita.

36 It should be mentioned, that this target was set above the average target used for other ENPI countries (20%), because of the high share of RES in final energy consumption in Palestine.

Environmental improvements

The targets and the potential environmental improvements from increasing the share of RES are presented in Table 7-5 below. As the table shows, a 25-30% increase in the share of RES by 2020, will reduce consumption of fossil fuels by 128 and 216 ktoe, respectively. Based on the simplifying assumption that the additional RES energy would replace diesel fuels (with petroleum products the predominant energy carrier in the oPt), this equals avoided annual **CO_2 emissions of 344,996 – 589,930 tonnes** compared to business as usual, based on an emission factor for diesel of 2.67 $kgCO_2/l$ or 2.72 tCO_2/toe.

Table 7-5 Targets for share of RES in final energy consumption in 2020 and the resulting environmental improvements

	Estimated gross final energy consumption in 2020[37]	Target	Target amount of gross final energy consumption from RES	Target amount of (reduced) fossil fuel consumption if target met	**Environmental improvement: ie reduced amount of fossil fuels if target met**
	ktoe	%	ktoe	ktoe	**ktoe**
Low target	1.762	25%	440	1.322	**128**
High target	1.762	30%	529	1.233	**216**

Source: Author's own compilation

7.2.3 Qualitative assessment of the benefits of increasing the uptake of renewable energy sources

Increasing the share of RES in the oPt has several social and economic benefits. To begin with, the oPt is strongly dependent on Israel for electricity generation, as 92% of its electricity is imported from the Israel Electrical Company. This means that the price of energy in the oPt is highly sensitive to fluctuations both in the global energy market and to the tariffs imposed by the Israeli Electricity Company. In addition, the oPt imports 100% of its petroleum products from Israel. In 2007, this amounted to an **energy bill of about EUR 385 million**, **nearly 10% of the oPt GDP.** Hence, reducing dependency on fossil fuels has great potential in decreasing energy expenditures on the long-run and increasing energy security in the oPt.

For example, it is estimated that current SWH capacity (about 940 GWh) saves about EUR 85 million of energy expenditures in the occupied Palestinian territory every year (Yaseen, 2009). It is also estimated that the market for SWH, currently assessed at some EUR 13 million, can be doubled if proper support policies with efficient financial incentives are implemented (Ibid). Further social and economic benefits will result from job creation in the RES market, especially for small and locally produced RES systems (manufacture, installation and maintenance of Solar Water Heaters, biogas systems, etc.).

High and fluctuating energy prices strongly affect households in the oPt, as no subsidizing policy for energy is in place. Electricity prices vary across different regions and sectors,

37 For reasons of simplicity, we used the lower end of estimated final energy consumption in 2020 for calculating the target. A similar estimation can be done for the higher end of consumption.

according to the tariffs imposed by each municipality or regional energy provider. Overall, electricity prices ranged between 0.09-013€/kWh in 2008, **and the energy bill accounted for about 10% of a family income.** In the same year, prices of gasoline and diesel were 0.92€/liter and 0.72€/liter respectively. Table 7-6 presents energy prices in the oPt in 2008 (Yaseen, 2009).

Table 7-6 Consumer Energy Prices in the oPt, 2008

Price of Electricity	0.09 – 0.13 €/kWh
Price of Gasoline	0.92 €/litre
Price of Diesel	0.72 €/litre
Price of Liquid Fuel	0.3 €/Kg
Price of Kerosene	0.72 €/litre
Price of firewood	95 €/ton

Source: (Yaseen, 2009)

Hence, increasing the share of RES can reduce substantially households' expenditures on energy. For example, a geothermal energy system has been installed in a residential district Etihad in Ramallah, with a cooling and heating capacity of 25 kW. This system provides 4.5 units of energy for every unit it uses, thus reducing annual heating and cooling costs by 70%, from 3,000$ to 850$ per year (Yaseen, 2009).

Furthermore, in 2007 about 18,500 inhabitants in the occupied Palestinian territory (0.5% of the total population) had no electricity supply and about 165,000 inhabitants (4.5% of the total population) had only partial electricity services through decentralized diesel generators. Thus, increasing the share of RES can provide solutions for rural populations suffering from lack of adequate connection to electricity supply, e.g. through local renewable energy supply installations. For example, a PV centralized power system has recently been implemented by the energy research center at An Najah National University, in a small Palestinian village called Atouf. The system has a power capacity of about 24 kWp, which provides electricity to the village, including 25 households, a school and a clinic. Similarly, a wind energy project is planned to be implemented in Al-Ahli Hospital in Hebron, which is located at about 1000 m above sea level (where wind potential is relatively high, ranging from 7-10 m/s). This project is expected to provide about 750 kW of energy supply for the hospital (Yaseen, 2009).

7.2.4 Monetary assessment of the benefits of increasing the uptake of renewable energy sources

The above mentioned environmental improvements will lead to a reduction of 344,996 – 589,930 tonnes of CO_2 per year compared to business as usual. Table 7-7 presents the monetary benefits that could be obtained from the CO_2 reductions, based on three estimates of the price of carbon in the global market, for each of the possible RES targets (25% and 30%). **The monetary benefits for a 25% RES target range between EUR 7-19 million. The monetary benefits for a 30% RES target range between EUR 11.8-33 million.**

Table 7-7: Estimations of monetary benefits from increasing the uptake of RES

Carbon price estimates	25% RES target			30% RES target		
	Emissions saved	CO_2 value	Monetary benefit	Emissions saved	CO2 value	Monetary benefit
	tCO_2	€/t CO_2	€	tCO_2	€/tCO_2	€
Lower bound	344.996	20	6,899.920	589,930	20	11.798,600
Medium est.	344.996	39	13,454.844	589,930	39	23.007,270
Higher bound	344.996	56	19.319,776	589.930	56	33,036,080

Source: Author's own compilation

The benefits over the period 2010 to 2020 would start lower (as current RES is below the 25 and 30% targets) and increase as progress is made to the 2020 target. After 2020 the renewable share will continue to lead to benefits of avoided CO2 savings over the operational lifetime of the technology

It should be mentioned, that currently the oPt – lacking statehood – is not a signatory to the Kyoto Protocol and thus cannot participate in carbon trading schemes such as CDM. However, to the extent that this will be a possibility in the future, the oPt could gain monetary benefits from implementing projects for reducing greenhouse gas emissions, which can be sold as carbon credits in carbon trading schemes such as CDM and JI.

7.3 Benefits from adapting to climate change

7.3.1 Overview of key climate change impacts

Introduction

The occupied Palestinian territory has a Mediterranean climate, which is characterized by winter rain and summer drought. Locally, climate is very diverse in different latitudes and altitudes, particularly in the West Bank where climatic zones range from extremely arid to humid (Land Research Centre, 2007). Annual rainfall in the West Bank is highest in the North (ca 700mm around Jenin) and lowest in the Dead Sea Area in the south (80-100mm); the western slopes receive 500-600mm and the eastern slopes only 45-150mm (UNDP, 2010). Gaza, despite its small size shows significant variations in climate. As such, average seasonal rainfall is 522mm in the north and 255 in the south (Palestinian Water Authority, 2007). The winters are mild, while the summers are hot and dry in the Gaza Strip.

Global warming is already affecting the Gaza Strip with a mean daily temperature increase of 0.4°C between 1976 and 1995 (El-Kadi, 2005).

Nine extreme weather events were identified for the period from 1997-2004. These include acute heat waves (July-August 1998, July 200, May 2004), a major sandstorm induced by the lowest recorded atmospheric pressure (May 2003) and heavy spring storms in the West Bank (March 1997) and Jerusalem (January 1999) (Applied Research Institute-Jerusalem, 2006, in UNDP, 2010)

With agriculture being the main source of livelihoods of rural communities in the West Bank, the Jericho and Al-Aghwar areas are considered the food basket of the West Bank. It provides around 108.8 thousand tons of vegetables, fruits, field crops, and forage and forms 13.7 percent of West Bank plant production. 24% of the population is employed in the agricultural sector, which accounts for 5% of GDP nationally. The revenues from food production and the livelihoods depending on them are increasingly at risk as climate change impacts exacerbate.

Human and natural vulnerability is especially high in the agricultural sector in the West Bank and Gaza Strip, particularly related to decreased and more variable rainfall. High social vulnerability aggravates the physical scarcity of resources in the West Bank and Gaza Strip. Additionally, particularly in the Gaza Strip, the high climate vulnerability is compounded by human-induced scarcity, essentially due to the ongoing conflict and the restriction that it imposes. Livelihoods can collapse as a result of climate vulnerability which, together with minimal public health and social breakdown to name a few, can lead to internal political tensions and a substantial dependence on donor assistance (UNDP, 2010). UNDP (2010) identified six major risks linked to vulnerabilities in relation to key climate-induced risks to food and water security namely: crop areas changes due to decreases in optimal farming conditions, decreased crop and livestock productivity, increased risk of floods, increased risk of drought and water scarcity, increased irrigation requirements and increased risks to public health from reduced drinking water quality (including saline intrusion in the coastal groundwater aquifer, which supplies the Gaza strip).

The sensitivities of the agricultural and water sector and their overall socio-economic importance, call for a prioritization in adaptation measures. A list of proposed adaptation measures by UNDP (2010) can be found in Annex 2.

Further, Mimi and Jamos (2010) propose and assess the following adaptation options outlined in Table 7-8 :

Table 7-8 Adaptation options, their adaptive, technical feasibility and potential cost

Measures to adapt to increased drought and water scarcity	**Adaptive capacity**	**Technical feasibility**	**Potential Cost**
Set clear water use priorities	High	High	Low
Increase water use efficiency	High	High	High
Increase rainfall interception capacity	High	High	High
Improve field drainage and soil adsorption capacity	Low	Medium	Medium
Alter crop rotations to introduce crops more tolerant to heat/drought	High	Medium	Medium

Source: Mimi and Jamos (2010)

Mizyed (2009) suggests the utilization of non-conventional water sources such as treated wastewater and brackish water, desalination of brackish and sea water as well as water harvesting as adaptation options.

Water Resource Availability/ Scarcity

During the last three years (2007-2010), the oPt experienced serious winter droughts. In the past eight years, the average precipitation level for the West Bank and Gaza has decreased by 12% below the historic average (UNDP, 2010). 2007/2008 has further seen a drastic drop in rainfall for the entire Palestine area (Ministry of Agriculture, 2008).

Mimi et al (2003) predicted that the occupied Palestinian territory will experience a serious water shortage of 271 MCM as of 2020. Climate change will mainly affect the start and duration of the different seasons as well as the quantity of rainfall. As a consequence, periods of heavier rainfall are concentrated in shorter time leading to increased run-off, soil erosion and decreased absorption capacities of the soil. The consequent lower quantities of retained water results in a lower pasture production will force herders to purchase fodder, while lower quantities of water can be harvested and stored in cisterns, forcing increased purchase of tanked water (Mimi and Jamos, 2010).

Mizyed (2009) shows in a study that the predicted temperature increase between 2°C and 6°C in the West Bank can increase evapotranspiration from 6 to 17%, thus reducing natural recharge of groundwater aquifers by 7-21% due to temperature increase alone. A possible 16% reduction in precipitation could result in reducing recharge of groundwater by around 30%. Combining this effect with a 6°C increase in temperature, the reduction in groundwater recharge will reach 50%.

The expected increase in seasonal temperature variability, storminess and frequency of temperature extremes can be a danger for cold and heat sensitive crops. Hotter temperatures, shorter winters joint with anticipated decreases in water availability are anticipated to increase drought damages (Mimi and Jamos, 2010).

The projection of future climate change impacts is constrained by the absence of high-resolution climate modelling for the oPt, the lack of scientific observations on regional atmospheric conditions and the limited long-term time-series data available. The Climate Changed Adaptation Strategy for Palestine provides the most complete and accurate summary of the current climate conditions and the likely climate change impacts expected over time (Mason et al. 2010).

Sea Level Rise

The coastline of the Gaza Strip is 40 km long, with 100% of its inhabitants living within 100km of the coast (AFED, 2009: data for 2000). The Israeli MoEP (2010) estimates that the seal level could rise by 0.5 meters by 2050 and by 1 m by 2100. A 10 cm rise will lead to a 2-10 meter retreat of the coastline and a loss of 0.4-2 km² of coast every 10 years. A one meter increase will flood a 50-100 meter belt on sandy beaches.38 Given this scenario, and in the absence of protective measures, the road spanning along the entire Gaza coast would be completely flooded by 2100 as well as parts of the cities Dayr al- Balah, Wahsh and Gaza, particularly the Shati district (google maps).

The coastal aquifer being the major source of drinking water for residents of the Gaza Strip, will be severely threatened by the sea level rise. The coastal aquifer is approximately 150 m deep along the coastline and shallows out to a few meters about 10km eastward from the coastline. Already, in some areas of over-pumping, wells have become saline because of seawater intrusion into the aquifer, and had to be shut down as water and irrigation sources. Studies estimate that the sea level rise of 50 cm could result in a loss of groundwater of 16.3 MCM per km of coast. This loss may worsen if the frequency of arid years increase and rainfall patterns change to short and intense rainfall, resulting in decreased aquifer recharge rate (MoEP, 2010). Estimates state that 155 MCM/yr are withdrawn from the coastal aquifer in Gaza, while the natural replenishment rate lies at only 87 MCM/year (Weinthal et al, 2005). Consequently, Gaza is currently over-abstracting water of approximately 68MCM/yr, which already leads to a noticeable degradation of water quality. A further loss in groundwater due to sea water intrusion would have a devastating impact on the water supply for Gaza.

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38 These estimates were made by the Israeli Ministry of Environmental Protection in 2010 for the Israeli case. A slope of 1-5% is assumed. Given the similarities in the coastline of Gaza and Israel, we propose to adopt these numbers for the Palestinian case.

The coastal infrastructure, i.e. the coastal road and wastewater treatment plants, needs to be adapted to rising sea levels.

Temperature increase in the Mediterranean Sea

The temperature of the Mediterranean Sea is expected to increase by 1-2°C (IPCC, 2007). Increased temperature is expected to lead to the intrusion of alien species in the Mediterranean, originating in the Red Sea and Indian Ocean. The consequent displacement of local biota will damage the fisheries as alien species (e.g. jellyfish) are expected to have a lower nutritional value. In addition, jellyfish can sting, damaging any tourism potential (MoEP, 2010). This will impact the 1500 licensed fishermen in the Gaza Strip (GEF, UNDP/PAPP, 2000). GDP from agriculture and fishing amounted to 334 mil US$ in 2006 (8% of GDP), however it is not known what proportion of this would be adversely impacted (PCBS, 2006).

Disease Outbreaks

Increased extreme weather events along with higher temperatures could increase the mosquito population, change its distribution and – with a low probability – result in a renewed outbreak of malaria in the region. Higher temperatures in the beginning of spring may result in an earlier appearance of the West Nile Fever. Further, increased heat stress may harm the elderly, the sick and workers exposed to the heat (MoEP, 2010).

As adaptation measures, the control and monitoring of disease carrying vectors needs to be enhanced, risk assessments need to be made. Further, health experts should be trained for and health systems should adapt to the future challenges relating to climate-induced disease outbreaks. The public should be educated, while urban planning should attempt to reduce heat stress and air pollution.

Desertification and biodiversity loss (impact on ecosystem goods and services)

Given a rise of 1.5°C, a spatial shift in the distribution of the flora and fauna by 300-500km northward can be expected, with the desert line moving northward and the Mediterranean systems at the edge of the desert turning into desert. Only resilient organisms will survive; invasive tropical species are expected to occur. Further, the likelihood of forest fires will increase. Economic costs of the impacts of climate change on biodiversity include: damages to (potential) tourism, efforts to rescue and restore endangered species, loss of water resources, and restoration of forests after fires.

Forest resources and their human interface need enhanced management, while the selection of more heat- and drought-resistant tree species for afforestation could help to slow down the desertification trends.

7.3.2 Potential environmental improvements

Water Resource Availability

It should be noted at the outset that, beyond the question of decreasing water availability and increasing water demands due to climate change, the issue of water scarcity and access to water cannot be viewed in isolation of the political conflicts around the distribution of water. Israel continues to control all water abstraction in the occupied Palestinian territories, and gross inequalities continue to exist between the Palestinian population, Israeli settlers and Israelis living in green-line Israel in terms water abstraction and water use per capita (see chapter 4.4 for a more detailed discussion).

Regarding the impact of climate change on water availability and water use, Mimi and Jamos (2010) modelled various scenarios of increased temperature and changes in precipitation and their impact on irrigation water requirements (MCM/year). The study came to the following results:

Table 7-9 Irrigation water requirement under different incremental climatic change scenarios in MCM/Y

(%)	T	T+1	T+2	T+3
P-20	21.05	21.63	22.23	22.83
P-10	20.24	20.82	21.42	22.01
P	19.95	20.53	21.12	21.71
P+10	19.66	20.24	20.83	21.42
P+20	19.38	19.96	20.54	21.13

Source: Mimi and Jamos (2010)

When considering a climate scenario of increased temperatures by 2°C (see methodology), the following additional water demands (compared to the baseline scenario of 19.95 MCM/year) become apparent:

Table 7-10 Additional Irrigation Water Requirements (MCM/year) in Jericho and Al-Aghwar - various scenarios

For scenario T+2	Additional Irrigation Water Requirement (MCM/year) in Jericho and Al- Aghwar)
P-20	2.28
P-10	1.47
P	1.17
P+10	0.88
P+20	0.59

Source: Mimi and Jamos (2010)

Currently, annual water losses (leakage) in Jericho amount to 20% or 0.736 MCM (Palestinian Water Authority). If these losses were reduced, more water would be available in addition to the current excess water of 1,2 MCM/ year. This could potentially buffer the additional water needed in scenarios P+20, P+10 and P (Table 7-10). However, further adaptation measures are needed in the case of the realization of the scenarios T+2 and P-10 and P-20[39].

39 These numbers need to be treated with care. While the increased irrigation water requirements are calculated for Jericho and Al-Aghwar, the water availability data only includes Jericho.

7.3.3 Qualitative assessment of the benefits of reducing the impacts of climate change

Water Resources Availability

Considering the multidimensionality of water, benefits to adapting to resource availability can be found on all spheres.

The increased availability of water due to decreasing water losses could be used to further secure the growing and marketing of pre-season food to European markets. Further, employment opportunities in the agricultural sector are maintained and, depending on the adaptation method, increased. Considering the impact of locally grown goods on food prices, the maintained yields of crops secure a competitively and socially desirable pricing.

Securing the local production of agricultural products, the number of households vulnerable to food insecurity (10.7% of HH) should be stabled or even decreased. Thus, it can be expected that currently marginally secure households (38.5% of HH) will not suffer from food insecurity and its resultant negative implications such as malnutrition (health benefits), riots, lower school attendance etc.

Food security and clean drinking water sources lead to an improved health and the avoidance of malnutrition and related diseases. This again results in higher numbers of economically active people, a precondition to decrease household poverty and resultant food insecurity.

An adapted water management and related agricultural practices can be expected to have positive environmental benefits in slowing down desertification and land erosion.

As part of a pilot project, small-scale activated sludge filtration systems of wastewater treatment were introduced in a village of 180 households. In addition to decreasing environmental problems and health hazards related to discharge of non-treated wastewater, the treated wastewater was used for irrigation purposes and resulted in increased yields and resultant benefits (food security, income) for these 180 households. Extrapolating this case study to all rural households without connection to sewage systems in the oPt can illustrate the benefits of this project, also as a way of adapting to climate change (Table 7-11 and Table 7-12).

Assuming that 187 projects could be realized, the potential benefits would amount to more than 10 million USD in terms of additional income from farming products. This does not even include the non-quantified benefits of an improved environment, food security and health situation. This far exceeds the estimated costs (of less than 3 million USD).

Table 7-11 Background Information - oPt SSWWT Case Study (duration 2007-2010, also see Chapter 3.5)

Item	Value	Source/comment
Population oPt	4,119,083	CIA Factbook (2010)
Rural Population	1,153,343	Calculations – centrally collected data: 28% of total population are rural population
Number of Households	624,970	WB 2010
Number of Rural HH	174,991	Calculation - Assumed that rural HH spread in same % as rural population
Average household size	6.3	PAPFAM
Population without connection to sewage network (rural %)	16	JMP (2008)
Population without connection to sewage network (rural #)	184,534	Calculations
Households without connection to sewage network	29,291	Calculations – Assumed average household size of 6.3
Estimated Population in 2020 (total)	5,454,000	WB 2010 (centrally collected)
Rate of rural population growth %	2,35	WB 2010 (CC)
Estimated rural population in 2020	1,454,913	Calculation 1,153,343*1,0235^10
Population without connection to sewage network (rural #)	211,758	Non-Connectivity is assumed to remain at 16%
HH without connection to sewage network (rural)	33,612	Assumption that HH size will not change

Table 7-12 Cost-Benefit Analysis of SSWWT Case Study in oPt

180 HH are served with 12 sludge filtration units (SSWWT)		
# of SSWWT needed in rural HH	187	
Costs		
Costs per SSWWT (NIS)	15,000 NIS	4,007 USD (average annual exchange rate 2010: (1 ILS =0.26714US$)
Total Costs (NIS)	2,801,032 NIS	748,268 USD (average annual exchange rate 2010: (1 ILS =0.26714US$)
Benefits		
Additional production of fruits and other crops from treated WW (per SSWWT)	502 kg	
Total additional produced fruit and other crops	93,874 kg	
Additional income of farming households with SSWWT (per HH)	303 US$	
Total income of farming households per SSWWT	54,540 US$	Assumption that all rural households engage in farming activities
Total additional farming income for 187 communities	10,198,980 US$	
Net Benefit	7,397,948 US$	
Non quantifiable benefits	Improved health and food security as well as environmental benefits	

Sea Level Rise
The economic benefits of adaptation against sea level rise consist in the protection of the coastal infrastructure against damage (both transport infrastructure and water supply / wastewater infrastructure). For transport infrastructure, the most important social and economic benefits are those delivered by the coastal road. For wastewater treatment facilities close to the coast (e.g. in Gaza City), the adaptation benefits are the environmental benefits of having the infrastructure in place and operational, i.e. less pollution in the Mediterranean Sea. A further impact of sea level rise is on the quality of the coastal groundwater aquifer, as an increased sea level will exacerbate the existing saline intrusion. As per adaptation options, the key option in this respect is to reduce the current over-abstraction of groundwater.

Disease outbreaks
Adaptation relating to climate change induced disease outbreaks and related health risks will mainly bring health benefits to the general public, with associated economic benefits (less sick leaves, and more stable household incomes). Possible vectors include the introduction of malaria or the West Nile Fever. However, this risk has not been assessed for the occupied Palestinian territories.

Desertification and biodiversity loss
Adapting the forestry to climate change-induced changes can result in environmental improvements as habitats are maintained and desertification slowed down. These improvements can directly translate into economic and social benefits, as residents can follow economic activities (e.g. collecting medical and aromatic plants for sale) and further secure their livelihoods (e.g. by sustainably collecting fire wood and food).

7.4 Benefits from reduced methane emissions from landfills

See Section 4.4 - Benefits from reducing methane emissions from waste

7.5 Benefits from reduced deforestation

See section 0 - Benefits from forests and reducing deforestation

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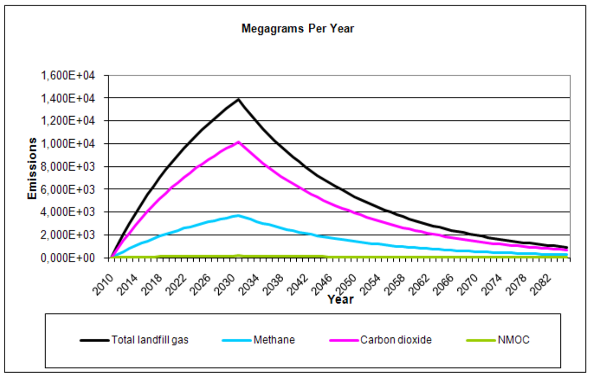
9 ANNEXES

Annex 1 - Methane genesis from landfills

The model of the EPA (United States Environmental Protection Agency) LANDGEM40 is used to assess the total emissions of landfill gas and of methane from a standardised landfill of 1.000.000 tonnes with a yearly input op 50.000 tonnes and a lifetime of 20 years. This can be a proxy for overall landfill emissions.



Total methane emissions are assessed at 170.164.940 m³ of methane emissions over the whole lifespan of the landfill plus its after-phase. **This can be translated in a ratio of 170 m³/tonne landfilled MSW**.

A conversion factor of 1:1,470 was set for converting methane emissions from volume (m^3) to weight (tonne), based on EPA online conversion calculator.[41]

40 Landfill Gas Emissions Model (LandGEM) Version 3.02 on http://www.epa.gov/ttn/catc/products.html#software
41 http://www.epa.gov/cmop/resources/converter.html

Annex 2 - Consequences for food and water security of the identified climate risks, adaptation options, option category, scale of implementation, adapative capacity, technical feasibility and potential cost

Consequences for food and water and security	Agricultural and water-sector adaptation	Category [1]	Scale [2]	Adaptive capacity [3]	Technical feasibility [3]	Potential cost [3]
Risks						
1. Crop area changes due to decreases in optimal farming conditions						
Main climatic causes of risk: Changes in monthly precipitation distribution Increased temperatures in critical periods Decreased groundwater recharge rates Increased erosion						
Farming optimal conditions altered resulting in increased risk to rural income	Rural livelihood diversification	M	N	H	M	M
	Strengthen capacity of agricultural extension services	M	N	M	M	M
	Irrigation of highest value crops	I	R	H	H	M
	Changing cultivation practices	M	R	M	H	H
	Increased freshwater use	I	R	H	H	M
	Switching to drought-resistant crops and ruminants	T	R	M	M	L
Loss of indigenous species	Introducing drought-resilient varieties of indigenous crops	T	R	M	M	L
Soils deterioration due to land use changes	Precision agriculture: improve soil and crop management	M	R	H	M	M

Consequences for food and water and security	Agricultural and water-sector adaptation	Category[1]	Scale[2]	Adaptive capacity[3]	Technical feasibility[3]	Potential cost[3]
2. Decreased crop and livestock productivity						
Main climatic causes of risk: Changes in monthly precipitation distribution Increased temperatures in critical periods (heat stress) Decreased groundwater recharge rates						
Crop productivity decrease	Change in cropping and grazing patterns for productivity gains	M	R	M	M	L
	Increased input of agro-chemicals	M	R	H	H	H
	Increased irrigation of main crops	I	R	H	H	H
Land abandonment	Adaptive land use planning	M	N	H	M	M
	Rural livelihood diversification	M	N	H	M	M
3. Increased risk of floods						
Main climatic causes of risk: Increase of extreme events frequency Increased magnitude of extreme events						
Increased expenditure in emergency and remediation actions	Contingency plan development	M	N	H	H	L
	Enhanced flood plain management	M	N	M	M	M
Flash flood frequency and intensity increase	Increased local-level rainfall interception (e.g. green lands)	M	R/U	H	H	L
	Reduction of grazing pressures to protect against soil erosion	M	R	M	M	M
Flooding	Increased drainage & storm runoff capacity	I	R/U	H	H	L/M
4. Increased risk of drought and water scarcity						
Main climatic causes of risk: Decreased annual and/or seasonal precipitation Decreased groundwater recharge rates Increase in the frequency of extreme conditions (droughts and heat waves)						
Conflicts among water users due to drought and water scarcity	Set clear water use priorities	M	N	H	H	L
	Increase water use efficiency	M	N	H	H	H
Water supply reduced	Increased regional-level rainfall interception (e.g. afforestation)	M	N	H	H	H
	Increased freshwater production	N	R/U	H	H	M
	Awareness-raising on water conservation techniques	I	R/U	M	H	L
	Improved field drainage and soil absorption capacity	T	R/U	L	M	M
	Use of drought tolerant crops and ruminants	M	R	H	M	M
	Local use of treated wastewater for agriculture	T	R	M	H	H
	Development of new water sources including desalination	I	N	H	H	H

Source: UNDP (2010) Climate Change Adaptation Strategy and Programme of Action for the Palestinian Authority