State of Palestine
Environment Quality Authority

Initial National Communication Report to the United Nations Framework Convention on Climate Change (UNFCCC)




2016

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Foreword

I am pleased to present the State of Palestine's Initial National Communication Report (INCR). This submission comes at a perfect time for the State of Palestine which has recently become a party to the United Nations Framework Convention on Climate Change (UNFCCC).

On behalf of the Palestinian people, the Palestinian leadership and president Mahmoud Abbas, I am delighted to confirm that on the 12th of December 2015 at the 21st Conference of Parties (COP) of the UNFCCC in Paris, the State of Palestine submitted the instrument of accession to UN Secretary General Ban Ki Moon. On the 17th of March 2016, the State of Palestine officially became the 197th party to the UNFCCC. It also ratified the Paris Agreement on the 22nd of April, 2016 and was one of the first countries to do so. This marks the end of Palestine being an "Observer State" to the convention. The COP 21 marked a historic climate agreement, and the Palestinian people are also celebrating by joining the convention. We are so proud of this achievement.

This INCR, which was developed in accordance with the recommended and applicable guidelines, highlights the key outcomes of our work on GHG inventories, analysis of mitigation and adaptation potentials, making it a vital source of information about GHGs emissions, the measures we are taking to tackle climate change, and the technical and institutional challenges faced. Palestine has developed this national communication as it recognizes the importance of better understanding the challenges of climate change. The process of developing this INCR involved all national stakeholders and experts. It was a two-year long process supported by UNDP/PAPP and the Government of Belgium and included a strong component of national capacity building.

I would like to extend my appreciation to all experts, policy-makers, academics, engineers and the team that have played a role in producing this extremely important communication. It is an important step forward for the State of Palestine.

I am also delighted to highlight that the State of Palestine has played an active and responsible role by undertaking climate change work prior to becoming a party to the convention, such as developing the "Palestinian Climate Change Adaptation Strategy", "National Strategy, Action Programme and Integrated Financing Strategy to Combat Desertification", "Environment Sector Strategy (2014-2016)" and the "National Strategy for Environmental Awareness and Education" among others. Additionally, work on this INCR had started at the end of 2014 highlighting our commitment and leadership to tackle climate change. Therefore, with our accession, we will continue to shoulder our responsibility as part of humanity and as a responsible state in the global fight to tackle climate change.

The State of Palestine is strengthening its pillars in the international arena and we will continue to act as we move forward in our struggle to put an end to the Israeli occupation of our land composed of the West Bank including East Jerusalem and Gaza Strip and we will continue to seek the full independence of our state. The task of tackling climate change is ever-more daunting as we remain under foreign occupation.

I am hopeful, and yet confident, that our national plan for adaptation to climate change as well as our plan for mitigation will bring success. We have worked hard to develop them, and to strengthen mechanisms and capacities of our national institutions to ensure that its goals and targets are achieved. The hard work of the national team in the government, in the private sector and in civil society, will make this a success story of comprehensive, sustainable development and will empower the national economy that will drive growth and prosperity for future generations. We look to our international partners to kindly support our efforts by donating efforts and resources generously, whilst we aspire to sovereignty, freedom and independency of our state.

We look forward to play our part in addressing climate change as a new party to the convention and submitting this comprehensive national communication is our first step forward.

Eng. Adalah Atirah
Chairman of Environment Quality Authority

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For further information and access to the report online visit

http://environment.pna.ps/ar/index.php?p=home

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The process of preparing the State of Palestine's Initial National Communication Report (INCR) to the United Nations Framework Convention on Climate Change (UNFCCC) included the participation of a wide range of institutions, as well as experts, professionals, researchers, activists and other members of the climate change community in the State of Palestine. Many thanks are extended to the positive and influential involvement of the stakeholders identified below and to all others who have provided input along the way; this project could not have been completed without their drive and expertise.

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[1] MOPAD is now the Ministry of Finance and Planning (MOFP)

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Special thanks have to be spared for PCBS and the National Committee for Climate Change (NCCC) for their support, guidance and hard work in the development of this INCR.

[2] MOPAD is now the Ministry of Finance and Planning (MOFP)

List of acronyms

Acronym	Definition
ACE	Action for Climate Empowerment
AD	Activity Data
AFOLU	Agriculture, Forestry and Other Land Use
AR2	Second Assessment Report of the Intergovernmental Panel on Climate Change
AR4	Fourth Assessment Report of the Intergovernmental Panel on Climate Change
AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change
BAU	Business-As-Usual
BMBF	German Federal Ministry of Education and Research
BTC	Belgian Development Cooperation
BUR	Biennial Update Reports
CDM	Clean Development Mechanism
CDP	Capacity Development Program
CH_4	Methane
CLICO	Climate change, hydro-conflict and human project
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2 eq.	Carbon Dioxide Equivalent
COD	Chemical Oxygen Demand
COP	Conference of Parties of the United Nations Framework Convention on Climate Change
CORDEX	Coordinated Regional Climate Downscaling Experiment
CTCN	Climate Technology Center and Network
DFID	Department for International Development (UK)
DRR/M	Disaster Risk Reduction and Management
DSROA	Data Supply and Reporting Obligation
DSWG	Data Supply Working Group
EF	Emission Factors
EIA	Environmental Impact Assessment
ENPI	European Neighbourhood Policy Initiative
EQA	Environment Quality Authority
ESCO	Energy Service Companies
EU SSF	European Union Palestine Single Support Framework
EV	Electric Vehicle
F-gases	Fluorinated Gases
FSN	Final Status Negotiations
GACMO	GHG Abatement Cost Model
GCF	Green Climate Fund
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GHGI	GHG Inventory
GIZ ACC	German Development Cooperation Programs on: Adapting to Climate Change
GIZ ACCW	GIZ Adaptation to Climate Change in the Water Sector
GIZ ORFM MENA	GIZ Open Regional Fund, Middle East and North Africa

Acronym	Definition
GPP	Gaza Power Plant
GS	Gaza Strip
GWP	Global Warming Potential
HEV	Hybrid Electric Vehicle
ICA	International Consultation and Analysis
INCR	Initial National Communication Report
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IRENA	International Renewable Energy Agency
JEEC	Joint Environmental Experts Committee
JWC	Joint Water Committee
l/c/d	Litres per capita per day
LAS	League of Arab States
LEAP	Long-Range Energy Alternatives Planning
LECRDS	Low-Emissions Climate Resilient Development Strategies
LEDS	Low Emission Development Strategy
LEEDS	Leadership in Energy and Environment Design
LPG	Liquid Petroleum Gas
M&E	Monitoring and Evaluation
MCM	Million Cubic Meter
MOA	Ministry of Agriculture
MOEHE	Ministry of Education and Higher Education
MOFP	Ministry of Finance and Planning
MOH	Ministry of Health
MOLG	Ministry of Local Governments
MONE	Ministry of National Economy
MOPAD	Ministry of Planning and Administration Development
MOT	Ministry of Transport
MRV	Measuring, Reporting and Verification
MSW	Municipal Solid Waste
N_2O	Nitrous Oxide
NAI	Non-Annex I Parties
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NC	National Communication
NCCC	National Committee for Climate Change
NCDP	National Capacity Development Program
NCECC	National Center of Excellence on Climate Change
NCF	National Climate Fund
NDA	National Designated Authority
NDC	Nationally Determined Contribution
NDP	National Development Plan
NE	Not Estimated
NEEAP	National Energy Efficiency Action Plan
NFP	National Focal Point

Acronym	Definition
NGO	Non-Governmental Organisation
NIFCC	National Institutional Framework for Climate Change
NMVOC	Non-methane volatile organic compound
NO	Not Occurring
NOx	Nitrogen Oxides
NSP	National Spatial Plan
PADRRIF	Palestinian Disaster Risk Reduction and Insurance Fund
PAPP	Program of Assistance to the Palestinian People
PCBS	Palestinian Central Bureau of Statistics
PCD	Palestinian Civil Defense
PENRA	Palestinian Energy and Natural Resources Authority
PFCs	Perfluorocarbons
PIPA	Palestinian Investment Promotion Agency
PMA	Palestine Monetary Authority
PMD	Palestinian Meteorological Department
PMR	Partnership for Market Readiness
PNA	Palestinian National Authority
PPFM	Palestinian Public Financial Management
PRDP TF	Palestinian Recovery and Development Program Multi Donor Trust Fund
PSI	Palestinian Solar Initiative
PV	Photo Voltaic (solar cell)
PWA	Palestinian Water Authority
QA	Quality Assurance
QC	Quality Control
RA	Reference Approach
RCP	Relative Concentration Pathways
RDF	Refuse-Derived Fuel
RICCAR	The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
SA	Sectoral Approach
SF_6	Sulphur Hexafluoride
SIDA	Swedish Development Cooperation with Palestine
SME	Small Medium Enterprises
SOM	Self Organizing Maps
SOx	Sulphur Oxides
SW	Solid Waste
SWDS	Solid Waste Dumping Sites
TJ	Tera Joules
UNDP	United National Development Program
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNRWA	United Nations Relief and Works Agency
USAID	United States Agency for International development
USD	United States Dollars ($)
V&A	Vulnerability and Adaptation
WB	West Bank
WMO	World Meteorological Organization

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Executive summary

National circumstances

Chapter 1 presents the State of Palestine's national circumstances.

The State of Palestine submitted the instrument of accession to the United Nations Framework Convention on Climate Change (UNFCCC) on 12 December 2015 at the annual Conference of Parties in Paris (COP 21). This accession entered into force and consequently the State of Palestine became a party on 17 March 2016 and marks the end of Palestine being an "Observer State" to the Convention. The State of Palestine will benefit greatly from becoming a party to the Convention and it will mean that the country can cooperate efficiently in achieving the Convention's goals.

The State of Palestine constitutes the Occupied Palestinian Territory, which is made up of the West Bank including East Jerusalem and the Gaza Strip, based on the June 1967 borders and are separated by Israel, the occupying power. The country is under Israeli occupation, and illegal Israeli settlements have been established throughout the West Bank and East Jerusalem. Consequently, the Palestinian Government does not have control over its own territory and natural resources, which are subject to systematic and widespread Israeli violations, and the Israeli occupation has a negative impact on the delivery of the Palestinian Government's environmental policies. The Gaza Strip has been suffering from a siege and blockade imposed by Israel for the past ten years, which has been severely affecting the viability of living conditions.

The State of Palestine is situated in the Middle East, a region that generally experiences four months of hot dry summer weather and a short winter with rain from November to March. The country is located in a unique position between different biogeographic regions: the Asian and African continents and the Mediterranean Sea. It is divided into five agro-ecological zones (the Jordan Valley, the Eastern Slopes, the Central Highlands, the Semi-Coastal Plain, and the Coastal Plain), which each have a very different climate. The Jordan Valley is warm and very dry in the south; the West Bank can be characterized as hot and dry during the summer and cool and wet in winter; the Central Highlands have occasional frost, snow and hail; while the coastal Gaza Strip is more temperate, even though it borders the desert. As a result of the country's biogeography and diverse climate, it has considerable importance for biodiversity.

Water is the most important issue on the Palestinian environmental agenda and access to water is among the most contentious points in the negotiations between Israel and the State of Palestine. The Israeli occupation limits access to available water resources and the Palestinian Government's capacities to improve the situation (e.g. constraining development of water storage reservoirs for harvesting rainfall). The State of Palestine relies on groundwater for more than 95% of its water needs, as Israel denies Palestinians' right of access to the only permanent river, the Jordan River. The main aquifers are the Western, North-Eastern, Eastern and Gaza Aquifers.

The Climate Change Adaptation Strategy and Program of Action for the Palestinian Authority has previously identified water and food security as the most vulnerable issues in the State of Palestine with knock-on implications for all sectors. Israeli occupation substantially reduces the State of Palestine's adaptive capacities in relation to many issues thereby compounding climate vulnerabilities. These limitations on the State of Palestine's adaptive capacities are most prevalent in Area C, which covers 61% of the West Bank, and in the Gaza Strip but Israeli occupation also increases vulnerabilities everywhere else.

The State of Palestine's population increased from 1.5 million in 1980 to 4.0 million in 2010 and is expected to reach 8.9 million by 2050. It is important to note that many Palestinians live as refugees or abroad. Nearly one-third of the registered Palestine refugees, more than 1.5 million, live in 58 recognized Palestinian refugee camps in Jordan, Lebanon, the Syrian Arab Republic, the Gaza Strip and the West Bank, including East Jerusalem[3].

Against the backdrop of a challenging political situation, where steps required by the international community have not materialized, Israel continues to impose constraints on the movement of people and goods. The ongoing occupation also prevents any restoration of business confidence and

[3] http://www.unrwa.org/palestine-refugees

investment. Israel maintains its blockade of Gaza, with ever increasing restrictions on crossing points, and constrains the movement of goods and people both within the State of Palestine and to other countries. Israel also continues to destroy Palestinian homes and businesses, as well as seize and deny access to their natural resources. These practices undermine efforts to build a strong economy and achieve fiscal independence. Hence, the State of Palestine's economic performance continues to decline, reflected in a low growth rate, increasing unemployment and poverty, inadequate investment, and a trade deficit.

In a holistic effort to improve conditions, the Palestinian Government developed a National Development Plan 2014-2016 (NDP) with policies and strategies designed to establish the sovereign state, consolidate its control over its natural resources, develop Area C (particularly in the Jordan Valley), and restore East Jerusalem and the Gaza Strip. The plan also signalled the State of Palestine's determination to boost its national economy, bolster its economic independence, and enhance the private sector's ability to build its productive capacity, its competitiveness and ability to create jobs for its people. The NDP 2014-16 continues the national endeavour to strengthen institutions, ensure financial stability and deliver quality public services efficiently and sustainably. The Environment Quality Authority (EQA) led the preparation and development of the Environment Sector Strategy (2014-2016) with the vision of: "A protected, maintained and safe Palestinian environment that achieves sustainability of natural resources, under an independent Palestinian sovereignty."

The State of Palestine is almost entirely dependent on imported energy supplies, specifically electricity and oil products. Political and logistical factors dictate that nearly all of these supplies at present come from Israel. Almost all of the electricity for the West Bank, including East Jerusalem, is supplied from power stations in Israel where associated greenhouse-gas (GHG) emissions reside. The only indigenous resources are small-scale solar water heating and some new wind-energy projects. The situation in the Gaza Strip is slightly different, as 30% of its electricity is supplied by the Gaza Power Plant (GPP). Despite the political situation, the State of Palestine's energy needs have continued to grow quite rapidly, due to population growth and some economic development.

Under such difficult circumstances, the Palestinian Government needs to strengthen its expertise, systems and capacity at the institutional level in order to address all of the issues that are linked to climate change adaptation and mitigation. It currently suffers from limited capacity, expertise, and a general limited ability to respond to these challenges.

National GHG Inventory

Chapter 2 presents the State of Palestine's anthropogenic (human-induced) emissions by sources, and removals by sinks, of all GHG not controlled by the Montreal Protocol.

The State of Palestine's anthropogenic (human-induced) GHG emissions have been estimated for the year 2011. However, the State of Palestine has gone beyond the requirements of the National Communication to produce a GHG inventory (GHGI) for a single year and has created a GHGI with a time-series from 2006-2013. The inventory was constructed using the 2006 IPCC inventory software in conjunction with the methodologies and emission factors set out in the 2006 IPCC guidelines.

State of Palestine's 2011 GHG by sector and by gas

In 2011, the country emitted 3,226.3 Gg CO_2 eq. A breakdown of the State of Palestine's total GHG emissions by sector is provided in Table 1 and by GHG in Table 2.

Table 1: The State of Palestine's total GHG emissions by sector

Sector	Total emissions (Gg CO_2 eq.)	Percentage of national emissions (%)
Energy	1997.7	62
Industrial processes and product use (IPPU)	Not estimated	--
Agriculture, Forestry and Other Land Use (AFOLU)	476.9	15
Waste	751.7	23

Table 2: The State of Palestine's total GHG emissions by GHG

GHG	Total emissions (Gg CO_2 eq.)	Percentage of national emissions (%)
Carbon dioxide: CO_2	1900.2	59
Methane: CH_4	802.6	25
Nitrous oxide: N_2O	523.5	16
Fluorinated gases	Not estimated	--
Indirect GHGs	Not estimated	--

The time-series shows that emissions steadily increased over time but there was no direct relationship between time and emissions, mainly because the majority of emissions came from fuel combustion in the energy sector and the consumption differed from year-to-year.

GHGI by sector

Energy

The energy sector emitted 1997.7 Gg of CO_2 eq. and dominated the State of Palestine's GHG emissions. Within the energy sector, CO_2 emissions dominated (97%), with relatively very small emissions of methane and nitrous oxide. All the emissions arose from the combustion of fuel. By sub-sector, the largest contributor to the energy sector's emissions was transport (47%) followed by residential (30%), energy industries (20%), and manufacturing industries and construction (3%). The three main fuels used were: gas/diesel oil, liquid petroleum gas (LPG) and wood waste.

The time-series for the energy sector shows an increasing trend in overall emissions. The main GHG driving this increase in emissions was CO_2. A potential explanation for the increasing trend is population growth and, hence, growing use of transportation, as well as increasing energy use by the residential sub-sector.

IPPU

The State of Palestine has no "heavy industry". It has some, but not extensive, "light industry". Moreover, the country does not have chemical, metal, or electronic industries. The GHGI does not, therefore, include any emissions from the IPPU sector.

AFOLU

Total net emissions from the AFOLU sector were 476.9 Gg CO_2 eq. and it is the only sector with carbon sinks. There was a net sink of -35.4 Gg CO_2 eq. Nitrous oxide emissions were 328.0 Gg CO_2 eq. and resulted from use of ammonium sulphate as a fertilizer. Emissions of methane were 184.3 Gg CO_2 eq. and resulted from livestock and manure management.

The time-series contains both emissions and removals. The emissions of nitrous oxide and methane were greater than the carbon sinks resulting in overall positive net emissions. However, net emissions in the AFOLU sector declined over time. This was because nitrous oxide and methane emissions overall decreased over time, coupled with carbon sinks being more or less the same over the period.

Waste

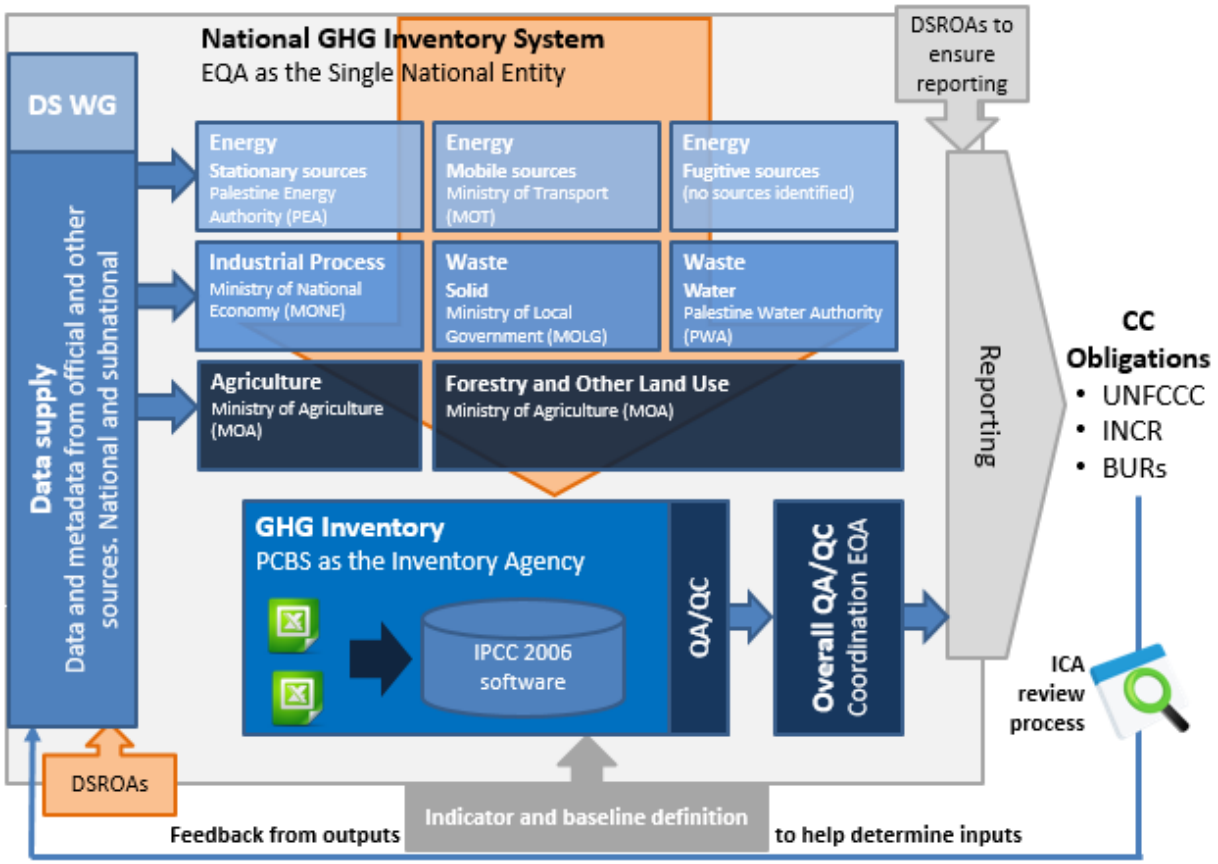
The waste sector emitted 751.7 Gg CO_2 eq. Emissions of methane dominated (76%), followed by nitrous oxide (23%). Most of the emissions from waste originated from industrial and domestic wastewater treatment and discharge (66%), while solid-waste disposal accounted for 31%. Open burning of waste accounted for only 3% of the total emissions from waste.

The time-series shows an increasing trend in emissions. This was because, with a growing population, waste disposal and wastewater discharge were also increasing.

GHGI institutional arrangement

The State of Palestine is in the process of establishing good quality institutional arrangements for the reliable and repeatable creation and reporting of its GHGI. To meet this end, the Palestinian Government has chosen the Environment Quality Authority (EQA) to be the single national entity responsible for developing the GHGI, and Palestinian Central Bureau of Statistics (PCBS) to be the GHGI agency. Establishing these institutional arrangements (Figure 1) are not a requirement for non-Annex I Parties but the State of Palestine has adopted them to ensure best practice and to set-up a solid foundation for future GHGI developments.

Figure 1: Institutional arrangements for the GHGI



Notes:

DSROAs = Data Supply and Reporting Obligations

BUR = Biennial Update Report

DS WG = Data Supply Working Group

ICA = International Consulting and Analysis

Assessment of GHG mitigation

Chapter 3 examines the various means and measures that the State of Palestine could implement to achieve a reduction in future GHG emissions.

The analysis of means and measures to achieve a reduction in future GHG emissions has been conducted on a sectoral level and the outputs comprise three elements:

- A projection of national GHG emissions up until and including the year 2030, under two baseline scenarios
- A quantitative analysis of the GHG mitigation options that are likely to be suitable for implementation in the State of Palestine

- A selection of suitable proposals for specific GHG mitigation projects.

When conducting a mitigation analysis, it is conventional to consider a single baseline pathway, referred to as the 'business-as-usual' (BAU) pathway. Given that there is some uncertainty in the future, the mitigation analysis for the State of Palestine makes use of two baseline pathways. The two baselines (the BAU 'independence' pathway and the BAU 'status quo' pathway) are intended to represent the GHG impacts arising from divergent political pathways.

The BAU 'independence' pathway assumes that the State of Palestine achieves full independence, securing unconditional control over its resources and an end to the occupation. This pathway sets out an emissions that account for the increased freedoms and economic activity that would ensue from the foundation of an independent state. The BAU 'independence' pathway has been designed to reflect the official plans of the Palestinian Government and has been developed in close co-operation with relevant organisations and stakeholders. Projections for important macroeconomic assumptions in the BAU 'independence' pathway were obtained from official institutions.

The analysis also considers a second baseline pathway, in which the current political situation is assumed to continue. This is referred to as the BAU 'status quo' pathway. It assumes reduced rates of population and economic growth, as might be expected from continued constraints on the State of Palestine. The preparation of the BAU 'status quo' pathway in no way implies an acceptance of the current political situation but rather is intended to showcase the detrimental impacts expected from a continuation of the current circumstances. Key macroeconomic assumptions are projected on the basis of current trends.

Three mitigation scenarios have been considered for each political pathway, each with mitigation actions implemented to varying degrees. This has led to a total of six scenarios; three based on the BAU 'independence' pathway and three on the 'status quo' pathway. The three scenarios for each pathway are as follows:

- A 'BAU' mitigation scenario; where it is assumed that no additional mitigation actions will be taken
- A 'realistic actions' mitigation scenario, where it is assumed that cost-effective GHG mitigation measures will be put in place
- An 'all actions' mitigation scenario, where it is assumed that all appropriate GHG mitigation actions will be enacted.

Baselines have been created for each sector using the Long-Range Energy Alternatives Planning (LEAP) energy-system model. Key assumptions for sectoral projections under the BAU 'independence' pathway are described below.

BAU pathway for electricity generation:

- The power station in Gaza will operate at full capacity (i.e. constraints on transmission capacity are resolved) and it will run on natural gas
- There will be an expansion of natural gas-fired generation capacity in both the West Bank and Gaza
- Electricity imports will be reduced to zero by 2040.

BAU pathway for the domestic sector:

- The key drivers of household demand will be the number of households (and so indirectly population), the energy intensity of households and the fuels used in households
- Occupancy rates and household energy demand will be constant, aside from efficiency increases as a consequence of the National Energy Efficiency Action Plan (NEEAP)
- There will be differences between household energy consumption between Gaza and the West Bank, both in terms of fuel type and total consumption.

BAU pathway for the industrial and commercial sectors:

- Commercial and industrial energy demand will be driven by gross domestic product (GDP) and the NEEAP

- There will be a new cement factory and expansion of industrial activity in the lime, chemical and food and drink sectors.

BAU pathway for transport:

- Car ownership will be driven by GDP and distance travelled per person will grow substantially
- Vehicle stock data is based on information from the Ministry of Transport.

BAU pathway for AFOLU:

- Agricultural activities will grow in line with population
- Forest coverage will remain constant.

BAU pathway for waste:

- The composition of waste will remain constant
- The quantity of generated waste will rise with population growth.

BAU pathway for water and wastewater:

- Future water demand, and, therefore, energy demand for desalination and treatment of wastewater, will be in accordance with the National Water Strategy
- Growth in water demand will be met by an increase in the capacity of desalination facilities
- Non-energy emissions are not included and energy use in these sectors is considered to be industrial.

GHG emissions under the BAU mitigation scenario

Anthropogenic emissions and removals of GHGs in the State of Palestine were estimated to be 3,450 Gg CO_2 eq. in the year 2015. Under the BAU 'independence' pathway, these emissions are projected to grow to 5,960 Gg CO_2 eq., 10,020 Gg CO_2 eq. and 18,060 Gg CO_2 eq. by 2020, 2030 and 2040 respectively; in rough terms, this is equivalent to a five-fold increase between 2015 and 2040. Under the BAU "status quo" pathway, GHG emissions are forecast to be 5,200 Gg CO_2 eq., 6,860 Gg CO_2 eq. and 9,130 Gg CO_2 eq. by 2020, 2030 and 2040 respectively. It should be emphasized that the comparatively lower projected emissions are not a consequence of mitigation measures but are due to limitations on economic growth and social progress, as a result of Israel's continued occupation.

The substantial projected increase in emissions under the BAU 'independence' pathway is largely driven by growth of the electricity-generation sector, where emissions rise from 340 Gg CO_2 eq. in 2015 to become around 9,070 Gg CO_2 eq. in 2040. This is equivalent to an annual growth rate of 9.8%. Emissions from electricity generation under the BAU 'independence' pathway are projected to be around 50% of total emissions in 2040 and will be nearly the same as total emissions in 2040 under the BAU 'status quo' pathway. By contrast, emissions from electricity generation are projected to be less than 10% of the total in 2015.

Growth in activity in the electricity-generation sector is projected to be driven by the construction of a number of natural gas-fired combined-cycle gas turbines. Accordingly, the increase in emissions can be seen as a consequence of the State of Palestine's increasing self-reliance. It is worth noting that the assumed reduction and ultimate elimination of electricity imports implies that emissions from electricity generation will be reduced in neighbouring countries.

Emissions from the industrial sector are projected to grow from 90 Gg CO_2 eq. in 2015 to 1,180 Gg CO_2 eq. in 2040. This is equivalent to an annual growth rate of 7.6%. It is assumed that a key driver of the growth in industrial emissions will be the combustion of coal in the manufacture of cement.

The transport sector is projected to emit 2,900 Gg CO_2 eq. in 2040. While the annual growth in emissions is around 2.1% per year, emissions from transport make up around 16% of the total in 2040. This makes the transport sector the second-highest source of emissions under the BAU 'independence'. Emissions are projected to be driven both by an increase in vehicle ownership and low scrappage rates for existing vehicles; the latter factor leading to ageing and, thus, inefficient vehicles on the road.

The residential, agricultural, commercial and waste sectors are projected to diminish in importance towards 2040. This is largely due to the rapid expansion of other sectors, as above. Projected emissions in 2040 are 1890 Gg CO_2 eq. for waste management, 1410 Gg CO_2 eq. for the residential sector, 1290

Gg CO_2 eq. for the agricultural sector and 320 Gg CO_2 eq. for the commercial sector. These equate to growth rates of 1.5%, 1.5%, 1.6% and 3.6% respectively.

Emissions per capita are forecast to grow to 1.6 Mg CO_2 eq. per person per year in 2040, from a 2011 figure of 0.8 Mg CO_2 eq. By comparison, per capita emissions in Jordan and Lebanon are 3.6 Mg CO_2 eq. and 4.7 Mg CO_2 eq. respectively.

Mitigation scenarios

In the 'realistic actions' mitigation scenarios, the analysis has considered five mitigation measures. These are: solar photo voltaic (PV), energy efficiency of buildings, use of waste for cement production, use of waste for electricity generation, and methane from landfill. The 'all actions' mitigation scenarios have considered a further set of measures: compressed natural gas-powered and plug-in electric-hybrid vehicles, modal shift programmes and afforestation.

The mitigation potential, costs and benefits of each measure have been evaluated, as part of the mitigation analysis. The analysis has used a conservative discount rate of 12% to evaluate the annual costs or benefits arising from investments in mitigation measures and programmes.

Assuming the foundation of an independent state under the BAU 'independence' pathway, the 'realistic' and 'all actions' mitigation scenarios lead to respective projected emissions of 14,200 Gg CO_2 eq. and 13,640 Gg CO_2 eq. in 2040. These figures correspond to reductions of 21.3% and 24.4%. The projected benefits from mitigation programmes is equal to USD 55.4 million for the 'realistic actions' mitigation scenario and USD13.3 million for the 'all actions' mitigation scenario. These benefits are direct financial savings and do not assume a price for avoided GHG emissions, or a valuation for non-monetary benefits.

Assuming a "status quo" scenario, the projected emissions in the 'realistic actions' and 'all actions' mitigation scenarios are 7,980 Gg CO_2 eq. and 7,950 Gg CO_2 eq. in 2040, equivalent to reductions of 12.5% and 12.8% respectively.

Vulnerability assessment and adaptation measures

Chapter 4 describes the State of Palestine's National Adaptation Plan (NAP), which was produced in parallel with this report.

The NAP process built on the UNFCCC's guidelines for least developed countries and the Climate Change Adaptation Strategy and Program of Action for the Palestinian Authority (2010). Issues that helped to define the process include: water and food security having previously been identified as the most vulnerable issues in the State of Palestine with knock-on implications for all other sectors; climatic vulnerability in the State of Palestine being dwarfed by existing non-climatic vulnerabilities; the West Bank and the Gaza Strip facing similar and differing vulnerabilities; a need to embrace climatic uncertainties; a lack of quantitative data relevant to identification and prioritization of vulnerabilities and adaptation options; and need to ensure common understanding and commitment amongst key stakeholders. The NAP process was agreed with stakeholders in the West Bank and the Gaza Strip from across 12 themes/sectors that were identified as potentially vulnerable.

Historic trends in climate in relation to the State of Palestine were assessed to aid consideration of climate sensitivities of potential vulnerabilities. The summary in Table 3 uses the terminology for confidence from the IPCC's Fifth Assessment Report (IPCC AR5).

Table 3: Historic trends in climate in the State of Palestine

Parameter	From the perspective of change
Average temperatures	Very *high* confidence that temperatures have risen over the past 100 years but less confidence in quantitative rates of change, due to spatial and temporal dependencies and data quality.
Temperature extremes	*High* confidence that warm days/nights and cold days/nights have increased/decreased respectively in frequency
Rainfall totals	*Very low* confidence that annual and seasonal rainfall totals have changed in either direction over the past 50 years or so but also *very low* confidence that there has been no change in annual and seasonal rainfall totals.

Parameter	From the perspective of change
Rainfall extremes	Only *very low* confidence can be ascribed to changes in rainfall extremes because of the limited evidence combined with the relative rarity of such events.

Assessments of potential vulnerabilities, associated with each of the 12 themes/sectors in the West Bank and the Gaza Strip, used definitions of terms in the IPCC AR5, which have changed since the AR4. As 'vulnerability' was, therefore, defined as "The propensity or predisposition [tendency] to be adversely affected", it was solely determined from assessing climate sensitivity and adaptive capacity in relation to each issue. This simplified the concept enabling stakeholders to input more readily and ensured that climate vulnerabilities were identified irrespective of future-climate scenarios, thereby embracing uncertainties. Issues ranked as 'Highly vulnerable' under Israeli occupation (Table 4) were the focus for identifying and prioritizing adaptation options.

Table 4: Issues ranked as "Highly vulnerable"

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

In keeping with the Climate Change Adaptation Strategy and Program of Action for the State of Palestine, the assessment found that many of the 'Highly vulnerable' issues in relation to water, agriculture and food also affect other themes/sectors. However importantly, many of the 'Highly vulnerable' issues have inter-connections more generally across themes/sectors, most notably, also in

relation to energy. Furthermore, Israeli occupation substantially reduces the State of Palestine's adaptive capacities in relation to many issues thereby compounding climate vulnerabilities.

Future-climate scenarios for the State of Palestine were developed from detailed assessment of IPCC AR5 projections to aid identification and prioritization of adaptation options (Table 5). The temporal and spatial details of regional model projections were not exploited, as scientific issues with them still need to be resolved. Scenario 1 is most likely if emissions align with the IPCC target of a global average temperature increase not exceeding 2°C; Scenario 2 is most likely if emissions continue to increase along recent lines with some reductions from historic levels but breaching the 2°C target; and Scenario 3 assumes that emissions continue unabated.

Table 5: Future-climate scenarios for the State of Palestine

Scenario 1	
Temperature	Increases by ~1°C by 2025, by ~1.5°C by 2055, by ~2°C by 2090.
Temperature-related	Reduced cold periods and warmer periods, both becoming more prominent in time.
Rainfall	Does not change, or perhaps increases slightly in the period to about 2035.
Rainfall-related	A slight possibility of more flooding. A small possibility of increased periods of drought but, in general, limited change overall to rainfall characteristics.
Scenario 2	
Temperature	Increases by ~1°C by 2025, by ~2°C by 2055, by ~3°C by 2090.
Temperature-related	Reduced cold periods and warmer periods, both becoming more prominent in time; more so than under Scenario 1.
Rainfall	Decreases by ~10% by 2025, by ~15% by 2055, by ~20% by 2090.
Rainfall-related	Little, probably no, possibility of increased flooding risk. High likelihood of more frequent droughts. Perhaps overall less rainfall per day of rain on average.
Scenario 3	
Temperature	Increases by ~1.5°C by 2025, by ~2.5°C by 2055, by ~4.5°C by 2090.
Temperature-related	Reduced cold periods and warmer periods, both becoming more prominent in time; perhaps moderated slightly in the Gaza Strip.
Rainfall	Decreases by ~20% throughout until 2055, and to ~30% by 2090.
Rainfall-related	In general, a pattern of reductions in average daily rainfall and in contributions to total rainfall by heavier rainfall days, extended dry periods and reduced wet periods; thus an increase in drought risk throughout. However, an indication that the rare wettest days might become more frequent, especially in the West Bank, thus, raising a possibility of an increased flood risk.

Adaptation options were identified that seek to reduce vulnerabilities by reducing climate sensitivity or increasing adaptive capacity and that are relevant to all three future-climate scenarios. They were prioritized in relation to a number of criteria (Impact; Efficacy; Timing/urgency for action; Social acceptance, Technology; Knowledge and skills; Costs for Years 1-5 and 5-10; Co-benefits for adaptation in other themes/sectors; Co-benefits for mitigation). Each adaptation option was also screened as to whether it would still be required if Israeli occupation was to be resolved and whether it could be taken only if Israeli occupation was to be resolved.

The NAP includes all adaptation options identified in relation to 'Highly vulnerable' issues, irrespective of their ranking. It is important to note that it is inappropriate to compare the priority of adaptation options between the West Bank and the Gaza Strip or between themes/sectors, as in each case relative scores have been used to rank options.

The international expert who developed the future-climate scenarios also reviewed requirements for the State of Palestine to generate its own climate modelling inputs to its future NAPs and NCs. Resultant costings for inclusion in the NAP were provided by the Palestinian Meteorological Department (PMD) (Total cost $2,120,000).

The process used to develop the State of Palestine's first NAP secured input from a wide cross-section of stakeholders and the commitment of all relevant ministries. It provides a firm foundation and living document on which to build on. Next steps will include: development of detailed funding proposals for international donors, international financial institutions and international funds; review of the Palestinian Government's thematic/sectoral strategies and policies to ensure that they are aligned with the NAP and thereby integrate and mainstream climate change adaptation; planning implementation of adaptation options (including spatial plans where data allow); establishing data requirements for future enhancement of the NAP and monitoring and evaluation; and capacity building and training (including for all other activities in this list).

Constraints and gaps, and related financial, technical and capacity needs

Chapter 5 describes the constraints and gaps and related financial, technical and capacity needs for each of the three main elements reported in this national communication: GHGI, mitigation assessment, and vulnerability and adaptation assessment.

GHGI

The Palestinian GHGI team needs technical and financial support to carry out the work to ensure the GHGI is complete and accurate, and to fully institutionalise the necessary inventory systems and processes.

Specific technical needs are:

- Further technical training on the approaches used to estimate emissions, and how to quality control the work done to create the estimates. Training sessions tailored to each of the sectors and their specific needs are required, as well sessions relevant to all the stakeholders involved in the creation and reporting of the GHGI.

Specific financial needs are:

- Financial support for training and capacity building activities
- Support for effective IT systems that are cost effective to maintain.

Specific capacity needs are:

- The capacity of the GHGI team needs to be strengthened. Simple succession and continuity planning is needed to ensure that the team can continue to function when staff change, or if there are short-term problems with the availability of staff.
- The key areas for capacity building are summarized directly below, based on the constraints and gaps identified:
    - Formal workshops and stakeholder mentoring to improve the quality of core sets of activity data for all sectors (including energy statistics, and technical and capacity support for AFOLU data collection)
    - Training institutions involved in the national GHGI system to allow them to deliver future reporting obligations repeatedly and reliably
    - Training PCBS to refine the overall data collection system and to adapt to new and improved sources of data in line with good quality assurance and quality control (QA/QC) practices
    - Training relevant ministries to improve data collection and in how to make estimates/assumptions when data is missing
    - Supporting the energy statistical team to extend the sectoral detail of the energy sector
    - Supporting the State of Palestine in raising public awareness about climate change.

Mitigation actions

Any mitigation analysis is only as good as the data that goes into it, and so data gathering needs to be a priority. The situation in the State of Palestine makes this particularly difficult. In addition, data needs to go through a process of systematic quality control before it is used.

Specific technical needs are:

- Technical training of relevant stakeholders to increase their understanding of the mitigation technologies that are available and could be used in the State of Palestine
- Technical training to share experience and best practice in the deployment of these mitigation technologies with similar regions (e.g. other parts of the Middle East).

Specific financial needs are:

- Provision of low-cost loans to support mitigation activities. As noted elsewhere, there are a number of projects that would deliver overall financial benefits to the State of Palestine but which have high upfront costs. Most renewable energy projects fall into this category. Unless finance at reasonable rates is available, these projects may be delayed or may not happen.
- Financial support for training and capacity building activities
- Support for effective IT systems that are cost effective to maintain.

Specific capacity needs are:

- Resources for relevant institutions to participate in feasibility or pilot projects to prove the viability of new technologies within the State of Palestine.
- Sector-specific training on LEAP software targeted to the sectors where mitigation is likely to deliver the best options for a lower carbon development pathway
- Training on measuring, reporting and verification (MRV) of the mitigation activities, including the use of indicators to track progress and outcomes
- Training all stakeholders, who have a role in implementing or monitoring mitigation activities, to understand what would constitute a good quality and efficient data-collection system and to adapt to new and improved sources of data and apply good QA/QC practices.

Adaptation

Specific technical needs are:

- Identified in relation to the adaptation options that address “highly vulnerable” issues in each theme/sector.

Specific financial needs are summarized in relation to each theme/sector in Table 6.

Table 6: Total cost of adaptation options for ‘Highly vulnerable’ issues included in the NAP

Theme/sector	West Bank Total cost (USD)	Gaza Strip Total cost (USD)	Total Cost (USD)
Agriculture	1,024,400,000	212,940,000	1,237,340,000
Coastal and marine	----------	114,000,000	114,000,000
Energy	267,046,000	176,000,000	443,046,000
Food	289,500,000	153,750,000	443,250,000
Gender	2,200,000	9,400,000	11,600,000
Health	8,530,000	3,750,000	12,280,000
Industry	171,800,000	77,500,000	249,300,000
Terrestrial ecosystems	12,000,000	1,400,000	13,400,000
Tourism	9,600,000	----------	9,600,000

Theme/sector	West Bank Total cost (USD)	Gaza Strip Total cost (USD)	Total Cost (USD)
Urban and infrastructure	31,000,000	22,600,000	53,600,000
Waste and wastewater	47,250,000	16,000,000	63,250,000
Water	311,300,000	582,200,000	893,500,000
GRAND TOTAL	**2,174,626,000**	**1,369,540,000**	**3,544,166,000**

These financial needs are:

- Related to the cost of each of the selected adaptation options in each theme/sector, which total USD3,544,166,000
- In addition, related to developments required for the State of Palestine to have the capability to generate its own climate modelling inputs to its future NAPs and National Communications. The total estimated cost of these requirements is USD 2,120,000.

Specific capacity needs are:

- Identified in relation to the adaptation options that address “highly vulnerable” issues in each theme/sector.

Other information considered relevant to the achievement of the objective the convention

Chapter 6 provides information on technology transfer; research and systematic observation; capacity building; as well as information and networking.

Technology transfer

To date, there has been some technology transfer to the State of Palestine. There is a well-established market for solar thermal, a developing market for PV, and energy-efficiency technologies have also been introduced (e.g. energy-efficient lighting). Other climate-related technologies for both mitigation and adaptation options have yet to penetrate the Palestinian market.

Research and systematic observation

The State of Palestine is a developing country and has limited financial resources available for climate research. Despite the financial and technical obstacles, the country has still made an effort to conduct various studies and research programs to understand the challenges and benefits of climate change mitigation and adaptation. The development of this Initial National Communication Report (INCR) has also facilitated research and compiled outcomes on key areas of mitigation and adaptation, such as historic climate trends, climate-change scenarios, vulnerability and adaptation, GHG inventories and mitigation potential.

Capacity building

Capacity building is crucial to the State of Palestine and should assist it to build, develop, strengthen, enhance, and improve capabilities to achieve both the objectives of the Convention and its national goals. The country has engaged in capacity building at both the activity level and at the governance and institutional level. In addition to the capacity building needed identified in “Constraints and gaps, and related financial, technical and capacity needs” above, climate modelling and national meteorological services need improvement. Moreover, now that the State of Palestine is a party to the UNFCCC, other key areas will need capacity building such as:

- Development of a complete MRV and monitoring and evaluation (M&E) system (described in more detail in Section 7.1.2)
- Identification, prioritisation and development of NAMAs
- Development of a Low Emission Development Strategy (LEDS)
- Negotiator training

- Capacities to create and report a Biennial Update Report.

The Palestinian Government will also consider whether it should engage with the Partnership for Market Readiness (PMR) and the Clean Development Mechanism (CDM). Depending on the outcome of these decisions, other specific capacity building requirements may be identified.

There is also a need to enhance the capacities of the State of Palestine's institutions to mainstream and address the challenges of climate change in the areas of reporting, mitigation, adaptation, and climate finance.

Information and networking

Information and network sharing at a national level is difficult due to the Israeli occupation. Flow of information, cooperation and coordination between staff members that work on climate change in both the West Bank and Gaza is jeopardized by road blocks, check points and the lack of possibility to move freely between both areas. Setting up meetings to discuss and plan climate change-related issues or face-to-face training is always subject to change and delays due to Israel's control over mobility. Impacts on information flow undoubtedly affect the quality of final outputs and hinders the State of Palestine's true potential to tackle climate change effectively. Despite these difficulties, the country has worked hard to institutionalize efforts to promote information sharing.

General description of steps taken or envisaged to implement the Convention

Chapter 7 describes the general description of steps taken or envisaged to implement the Convention.

Now that the State of Palestine is a party to the UNFCCC, it has already completed the first next step related to climate finance. It recently selected and nominated EQA as the Country's National Designated Authority (NDA) to the Green Climate Fund (GCF). In order to access the GCF fund and fulfil its duties as an NDA to the GCF, EQA will need to establish a number of institutional processes. Overall national climate finance and a good financial governance structure need to be established to lay the foundation for climate-finance readiness in the State of Palestine. This includes the establishment of a national climate-finance architecture and the integration of climate change into the public-finance system, which is important with regard to sourcing government institutions, as well as attracting further donor funding. Furthermore, a National Climate Fund (NCF), or a National Climate and Environment Fund, needs to be established and operationalized.

The State of Palestine is planning to develop an effective and efficient MRV system in order to fulfil its reporting requirements under the UNFCCC. It will allow the country to: maximise the effectiveness of its mitigation and adaptation actions, receive more international climate finance and gain an overview of climate finance and other types of international support received and ensure its effective use. The three areas for which MRV systems are relevant are:

- GHGI
- Mitigation
- Financial support.

The Palestinian Government also plans to develop an M&E process in relation to the NAP and will consider possible options for monitoring, as relevant to each of the highly vulnerable issues, in terms of changes in:

- Climate sensitivity and/or
- Related adaptive capacity and/or
- Vulnerability and/or
- Related direct and indirect impacts that may be attributed to climate change and/or
- Progress with implementation of related adaptation options.

Moreover, as a party to the UNFCCC, the State of Palestine has already started the preparations on its National Determined Contribution. Finally, The State of Palestine has developed a suggested roadmap for climate action to implement the INCR.

1 National Circumstances

1.1 Background

On 12 December 2015 at the annual Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris (COP21), the State of Palestine submitted the instrument of accession to United Nations Secretary General, Ban Ki Moon, in his capacity as a depositary for the convention. On 17 March 2016, the State of Palestine officially became the 197th party to UNFCCC. The country will benefit greatly from becoming a party to the Convention and it will mean that it can cooperate efficiently in achieving the Convention's goals. The State of Palestine signed and ratified the Paris Agreement on 22 April 2016.

The State of Palestine is particularly vulnerable to the impacts of climate change, which will not only have severe implications for its economy, society and environment but also for the region's wider political context. Water and food security are the most vulnerable issues in the State of Palestine with knock-on implications for all sectors. Israeli occupation substantially reduces the State of Palestine's adaptive capacities in relation to many issues thereby compounding climate vulnerabilities. These limitations on the State of Palestine's adaptive capacities are most prevalent in Area C, which covers 61% of the West Bank, and in the Gaza Strip but Israeli occupation also increases vulnerabilities everywhere else. The Israeli occupation of the State of Palestine exacerbates the difficulties of tackling adaptation and mitigation effectively.

The Palestinian Government intends to understand these challenges, and to play a role in the international efforts to tackle climate change. It plans to do its best to adopt low-emission development strategies, including reductions in energy and resource consumption and production of less waste, despite recognizing that developed countries should take the lead in reducing greenhouse-gas (GHG) emissions, as they are historically responsible for the largest proportion of accumulated GHGs in the atmosphere. The preparation of this INCR aims to enhance the capacity of the State of Palestine to mainstream and address the challenges of climate change, particularly in relation to adaptation and reporting and mitigation of GHG emissions.

Relevant government institutions, such as the Environment Quality Authority (EQA), Ministry of Agriculture (MOA), Palestinian Water Authority (PWA), Ministry of Transportation (MOT), Ministry of Finance and Planning[4] (MOFP), Ministry of National Economy (MONE), Palestinian Energy and Natural Resources Authority (PENRA), and the Ministry of Health (MOH) have limited systems, capacity and expertise to address these challenges efficiently.

1.2 Geography

The State of Palestine constitutes the Occupied Palestinian Territory, which is made up of the West Bank including East Jerusalem and the Gaza Strip, based on the borders of June 1967 and are separated by Israel, the occupying power. The total area of the country is 6,257 km^2 . Neighbouring countries include Jordan to the east and Egypt to the south. The Oslo II Accord, formally entitled the 'Interim Agreement on the West Bank and the Gaza Strip of 1995', created three territorial zones in The West Bank: Area A, where the Palestinian Government has responsibility for public order and internal security; Area B, where the Palestinian Government assumes responsibility for public order for Palestinians, while Israel controls internal security; and Area C, where Israel maintains exclusive control. The "Protocol concerning the redeployment in Hebron", dated 17 January 1997, divides the City of Hebron located in the West Bank into two: Areas H-1 and H-2. Palestinian police assume responsibilities in Area H-1 and Israel retains all powers for internal security and public order in Area H-2[5]. In addition, Israel maintains exclusive control over borders, external security, East Jerusalem and Israeli settlements.[6]

One of major impact of Israeli occupations is building settlements in the occupied territory. Settlements are built on the occupied Palestinian land which is the cause of many illegal practices against Palestinians such as forced displacements and restriction of Palestinian movements in addition to high

[4] MOFP used to be two ministries: the Ministry of Finance and the Ministry of Planning and Administration Development (MOPAD)
[5] Protocol concerning the redeployment of Hebron (1997) http://www.nad-plo.org/userfiles/file/Document/nsprotoredp1.pdf
[6] UNEP (2003) Desk study on the environment in the Occupied Palestinian Territories. www.unep.org/download_file.multilingual.asp?FileID=105

limitations of Palestinians access to land, water and other natural resources. The annexation and separation wall is among the negative impacts of illegal settlement regime which was used as a justification to protect the settlements. The international law considers the settlements as illegal since it violates article 49 of the fourth Geneva convention that banns the transfer of the occupying power's civilian population into occupied territory.

Israel has established about 159 colonial settlements since 1967 (residential and others) in the West Bank, including East Jerusalem; in addition to some 120 "outposts" constructed by settlers without official authorization, 93 military base, 16 industrial zone and 24 other service areas, that form as a total 412 area controlled by Israel.[7]

In 2002, Israel constructed the Annexation and Expansion Wall to separate the West Bank from Israel. However, the Wall's route is located within the West Bank, separating Palestinian communities and farming land from the rest of the West Bank and contributing to the further fragmentation of the State of Palestine. Some 85% of the Wall's route runs inside the West Bank, rather than along the Green Line, which is the 1949 Armistice line. The Wall consists of concrete walls, fences, ditches, razor wire, sand paths, an electronic-monitoring system, patrol roads, and a buffer zone. The Wall's total length (constructed and projected) is approximately 712 km. The wall also separates East Jerusalem from the rest of the West Bank preventing the movement of Palestinians unless Israel grants them a permit. Agriculture-based livelihoods of thousands of families have been undermined due to the permit and gate regime, which restricts access to farmland behind the Wall[8].

The Annexation and Expansion Wall has transformed the geography, economy and social life of Palestinians living in East Jerusalem, as well as the life of those residing in the wider metropolitan area. Neighbourhoods, suburbs and families have been divided from each other and from the urban center, and rural communities have been separated from their land in the Jerusalem periphery. In its 2004 Advisory Opinion, the International Court of Justice (ICJ) established that the sections of the Wall that run inside the West Bank, including East Jerusalem, together with the associated gate and permit regime, violate Israel's obligations under international law[9].

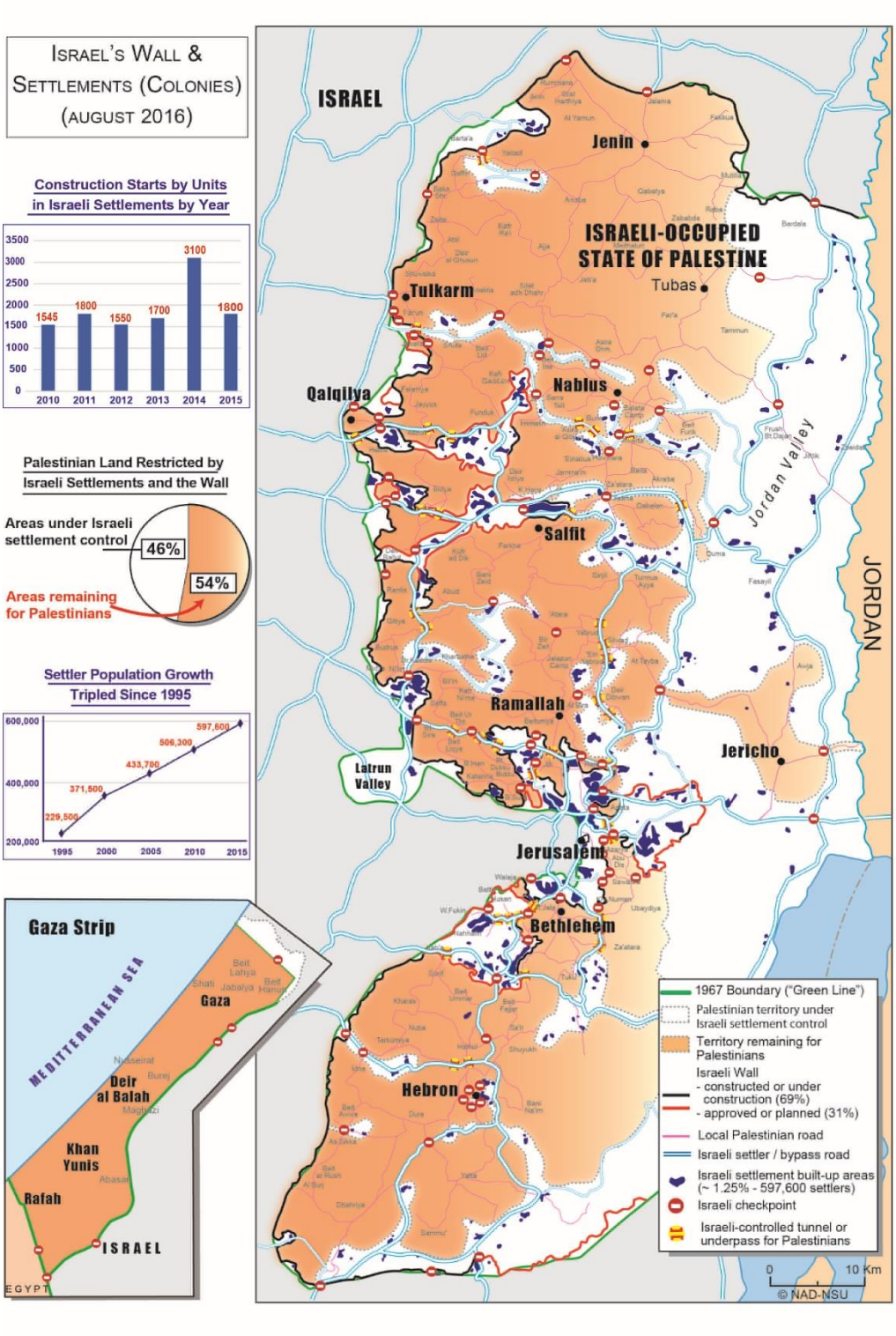
The Gaza Strip with a total area of 378 km^2 is under siege. The living conditions of nearly 2 million Palestinians residing in the Gaza Strip have been undermined by the enduring blockade against the enclave. Longstanding restrictions on the movement of people and goods to and from the Gaza Strip have led to steadily deteriorating living standards for the Gaza Strip's people, since the imposition of the Israeli blockade in June 2007. These restrictions have reduced access to livelihoods, essential services and housing, disrupted family life, and undermined the people's hopes for a secure and prosperous future.

Currently, Palestinians in the Gaza Strip can enter and exit the Strip through three access points: the Rafah Crossing connecting the Gaza Strip with Egypt; and the Kerem Shalom and Erez crossings connecting it with Israel. Two other crossings at Sufa and Karni have been closed[10].

[7] Israeli colonies in the West Bank 1997-2014, PLO.
[8] OCHA (2013) Humanitarian impact of the barrier. https://www.ochaopt.org/documents/ocha_opt_barrier_factsheet_july_2013_english.pdf
[9] OCHA (2013) Humanitarian impact of the barrier. https://www.ochaopt.org/documents/ocha_opt_barrier_factsheet_july_2013_english.pdf
[10] UN News Center (2015) Gaza: UN humanitarian arm warns that blockade 'undermining' living standards. www.un.org/apps/news/story.asp?NewsID=50251#.V0CmefkrK00

Figure 2: Maps of the State of Palestine[11].

[11] Negotiation Support Unit in the Negotiation Affairs Department of the State of Palestine


ISRAEL'S WALL & SETTLEMENTS (COLONIES) (AUGUST 2016)
Construction Starts by Units in Israeli Settlements by Year
3500
3000
2500
2000
1500
1000
500
0
1545
1800
1550
1700
3100
1800
2010
2011
2012
2013
2014
2015
Palestinian Land Restricted by Israeli Settlements and the Wall
Areas under Israeli settlement control
46%
54%
Areas remaining for Palestinians
Settler Population Growth Tripled Since 1995
600,000
400,000
200,000
229,500
371,500
433,700
506,300
597,600
1995
2000
2005
2010
2015
ISRAEL
Jenin
ISRAELI-OCCUPIED STATE OF PALESTINE
Tubas
Tulkarm
Qalqilya
Nablus
Jordan Valley
Salfit
JORDAN
Ramallah
Jericho
Latrun Valley
Jerusalem
Bethlehem
Hebron
Gaza Strip
MEDITERRANEAN SEA
Beit Lahiya
Shati
Jabalya
Beit Hanun
Gaza
Deir al Balah
Khan Yunis
Rafah
ISRAEL
EGYPT
1967 Boundary ("Green Line")
Palestinian territory under Israeli settlement control
Territory remaining for Palestinians
Israeli Wall
- constructed or under construction (69%)
- approved or planned (31%)
Local Palestinian road
Israeli settler / bypass road
Israeli settlement built-up areas (~ 1.25% - 597,600 settlers)
Israeli checkpoint
Israeli-controlled tunnel or underpass for Palestinians
0
10 Km
© NAD-NSU

The West Bank has a varied topography consisting of central highlands, where most of the population lives, and semi-arid rocky slopes, an arid rift valley and rich plains in the north and west. The West Bank is mostly composed of limestone hills that are between 700 to 900 metres high. The lowest point is the Dead Sea at 426[12] metres below sea level, and the highest is the Tall Asur at 1,022 metres above sea level. Brown lithosols and loessial arid brown soils cover the eastern slopes, with pockets of cultivation spreading over the steep slopes. Fertile soils are found in the plains. Soil cover is generally thin and rainfall is erratic. In all, about 12 percent of the land is desert, eroded or saline. The Gaza Strip is a narrow, low-lying stretch of sand dunes along the eastern Mediterranean Sea. It forms a foreshore plain that slopes gently up to an elevation of 90 metres. The sea is warm and saline and is affected by water outflow from the River Nile[13].

1.3 National and regional development priorities

The supreme national goal of the State of Palestine is to achieve complete independence and total liberty from the Israeli occupation and to establish a sovereign state based on the June 1967 borders, including East Jerusalem as its eternal capital. A National Development Plan 2014-2016 (NDP) was developed with policies and strategies designed to materialise the sovereign state and consolidate the State of Palestine's control over its natural resources, develop Area C (particularly in the Jordan Valley), and restore East Jerusalem and the Gaza Strip.

The plan also signals the State of Palestine's determined effort to boost its national economy, bolster its economic independence, and enhance the private sector's ability to build its productive capacity, its competitiveness and ability to create jobs for its people. The NDP 2014-16 continues the national endeavour to keep on strengthening institutions, ensuring financial stability, and delivering quality public services efficiently and sustainably.

The implementation of the NDP intends to redouble the effort to ensure a decent standard of living for all Palestinians. In doing so, it takes account of the differing needs and conditions of the Palestinian people. The main development goals are to work towards alleviating poverty, reducing unemployment, and promoting equality and social justice. The country will continue to strive for a robust democratic political system, grounded in the rule of law, pluralism, separation of powers, and peaceful transition of power. With due respect to human rights and fundamental freedoms, the political system is anchored in values of citizenship, integrity, transparency and accountability. The NDP 2014-16 also envisages enhancement of the role of the State of Palestine in Arab, regional and international forums, as well as accession to international treaties and conventions. In support of this endeavour, the State of Palestine will continue working to align its legislative framework and institutional structures with international norms.

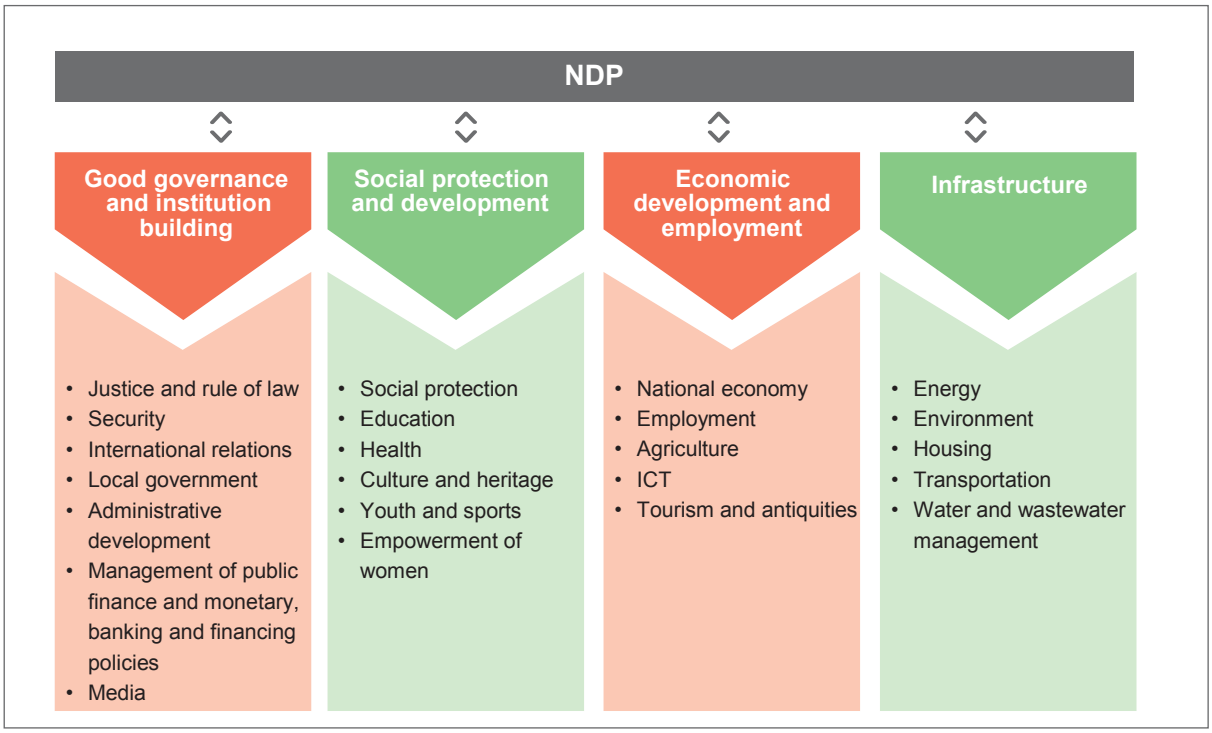
Other national goals are transparency, accountability, and respect for human rights, including first and foremost women's rights. The government reaffirms its continued constructive approach to state-building, despite the occupation, to underpin comprehensive, balanced and sustainable development. The NDP 2014-16 will, therefore, build upon the achievements of successive Palestinian Governments to ensure public institutions remain ready to govern the State of Palestine.

The sustenance and development of the Gaza Strip is a topmost priority. The State of Palestine is determined to drive development throughout the country and bridge the gap in socio-economic development gap between the West Bank and the Gaza Strip. Maximum efforts is being made to consolidate cooperation with local and international development partners in order to implement more development projects in the Gaza Strip, spanning the humanitarian, social, economic and infrastructure sectors.[14] In August 2015, the Prime Minister approved a report entitled "Detailed needs assessment

[12] The World Bank (2014) Red Sea-Dead Sea Water Conveyance Study Environmental and Social Assessment - Final Environmental and Social Assessment (ESA) Report – Executive Summary. http://siteresources.worldbank.org/EXTREDSEADEADSEA/Resources/5174616-1416839444345/ESA_ES_Mar_2014_English.pdf
[13] OCHA (2013) Humanitarian impact of the barrier. https://www.ochaopt.org/documents/ocha_opt_barrier_factsheet_july_2013_english.pdf
[14] State of Palestine (2014). National Development Plant 2014-16. http://www.mopad.pna.ps/en/images/PDFs/Palestine%20State_final.pdf

and recovery framework for Gaza reconstruction", which highlighted the national need and desire to rebuild Gaza.[15] Figure 3 highlights the State of Palestine's main priorities.

Figure 3: National Development Plan sectors and sub-sectors



1.4 Environment in the State of Palestine

Israel, the occupying power, has incessantly implemented its illegal policies and practices of settlement expansion, war and aggression on the Gaza Strip, home demolitions, uprooting of trees, systematic destruction of the natural environment and biodiversity, solid-waste dumping on Occupied Palestinian Territory, and maintaining its grip on Palestinian natural resources, including land and water. These illegal policies and practices continue to pose a major challenge, thwarting tangible progress in environmental conservation and development. In spite of the State of Palestine's scarce resources, some progress has been registered over the past years. The State of Palestine has recently finalized its "National Adaptation Plan" (NAP 2016) and had previously developed a "Climate Change Adaptation Strategy and Program of Action". It also developed and endorsed the "National Plan for Protection of Natural Resources and Historic Landmarks", finalized the "National Strategy, Action Programme and Integrated Financing Strategy to Combat Desertification", the "Environment Sector Strategy (2014-2016), the "National Strategy for Environmental Awareness and Education" and "Solid Waste Management Strategy". It released the 2013 report on Sustainable Development Indicators, promulgated by-laws on the Environment Law, and implemented some solid and liquid waste management projects. The State of Palestine will implement the Combat Desertification Strategy, continue to plant forest trees, and promote processes and provide capacity building to enable Palestinian institutions to adapt to climate change.[16]

The preparation of this National Communication is an important opportunity for facilitating the general public's understanding of the achievement of objectives and involving their participation in national implementation. Moreover, the analysis presented in this communication will help the State of Palestine to develop policies and a road map to tackle climate change threats in a more consistent and sustainable manner with regard to both adaptation and mitigation. In addition, it is also recognized that preparing and reporting of a national GHG inventory (GHGI) will provide great benefits to the State of Palestine, for example, informing assessments of economic development, providing information on the

[15] Ministerial committee for the Reconstruction of Gaza (2015) Detailed Needs Assessment (DNA) and Recovery Framework for Gaza Reconstruction. http://www.lacs.ps/documentsShow.aspx?ATT_ID=21974
[16] State of Palestine (2014). National Development Plant 2014-16. http://www.mopad.pna.ps/en/images/PDFs/Palestine%20State_final.pdf

utilisation of natural resources, and data on industrial demand and production. A GHGI will provide a foundation for progressing the evaluation of GHG mitigation options and assist with the implementation of a low-carbon development strategy. Looking ahead, it also opens the possibility of participating in emissions trading schemes, in addition to guiding decision-making processes with regard to mitigation scenarios.

1.4.1 Environment in the peace process

The situation in the State of Palestine is unique in the sense that the Palestinian Government has only limited control over its own territory and natural resources. Consequently, the Israeli occupation negatively influences implementation of internal policies, including environmental policies, and also limits the Palestinian Government's scope for action. In line with the Oslo II Accord, the Palestinian Government only has authority to decide freely in Areas A and B of the West Bank. In Area C, which covers 61 % of the West Bank[17], the Palestinian Government has no control. This has very practical implications for decisions, such as designating and accessing nature reserves and protected areas, establishing landfill sites, drilling wells, constructing sewage treatment plants, or implementing large infrastructure projects. Often, such projects can only be undertaken in Area C, as Areas A and B are typically urban and densely populated. However, any projects in Area C require the consent and cooperation of the Israeli Authorities.[18]

The Oslo I Accord, formally entitled the 'Declaration of Principles on Interim Self-Government Arrangement of 1993 between Israelis and Palestinians', includes annexes that outline cooperation in economic and development programmes (Annex III) and regional development programmes (Annex IV). These contain provisions that are of relevance to the environment. In Annex III, the parties agreed to establish an Israel-Palestinian Committee on Economic Cooperation focusing, among other matters, on environmental issues, such as water, energy and industry. The parties also agreed to develop an environmental protection plan, providing for joint and/or coordinated measures.

Under Article 12 of Annex I to the Oslo I Accord, which deals specifically with environmental protection, Israel transferred powers and responsibilities to the State of Palestine to undertake limited environmental management activities in the West Bank and the Gaza Strip[19]. Furthermore, Israel and the State of Palestine agreed to cooperate, on the basis of mutual understanding and shared responsibility, in virtually all areas of environmental protection. For example, the parties agreed, pursuant to their environmental and developmental policies, to:

- Prevent damage to the environment and take measures to ensure that activities in areas controlled or managed by one party do not cause environmental damage to areas controlled or managed by the other party
- Adopt, apply and comply with internationally recognized environmental standards concerning emissions and effluents
- Prevent uncontrolled discharge of wastewater and effluents to water bodies and promote proper treatment of wastewater, solid and hazardous wastes.
- Ensure that a comprehensive environmental impact assessment (EIA) is conducted for all major development programmes specified in the Accord
- Take precautions to prevent water and soil pollution, as well as other environmental safety hazards
- Take measures to prevent noise, dust and other nuisances from quarries
- Cooperate in the implementation of internationally accepted principles and standards of global environmental concern, such as protection of the ozone layer, protection of endangered species of fauna and flora, conservation of migratory species, and preservation of existing forests and natural resources
- Develop jointly a mechanism for mutual notification and coordination to respond to events or accidents likely to generate environmental pollution, damage or hazards; and

[17] State of Palestine (2014). National Development Plant 2014-16. http://www.mopad.pna.ps/en/images/PDFs/Palestine%20State_final.pdf
[18] ARCADIS, IEEP, ERM, Metroeconomica, Ecologic, Ecologic Institute, Palestine Wildlife Society (2011) Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection. http://www.enpi-info.eu/library/sites/default/files/attachments/OPT-ENPI%20Benefit%20Assessment.pdf
[19] The Israeli-Palestinian interim Agreement on the West Bank and the Gaza Strip, Annex III, Protocol Concerning Civil affairs (1995) http://www.nad-plo.org/userfiles/file/Document/annex3.pdf

- Cooperate to promote public awareness of environmental issues, to combat desertification, to carry out environmental studies, and to control transfer of pesticides.

In order to ensure effective collaboration on the environmental issues identified, the parties established a Joint Environmental Experts Committee (JEEC). Furthermore, under Annex VI to the Oslo II Accord ('Protocol concerning Israeli – Palestinian Co-operative Programmes') the parties agreed to cooperate on economically and environmentally sustainable development. In addition to the JEEC, various other environment-related collaborative committees were established, e.g. the Joint Water Committee (JWC). These committees met and cooperated until the outbreak of the Second Intifada in September 2000[20]. Most formal environmental cooperation has effectively been suspended since that time, although the JWC continued to meet periodically up until 2014. The reason for suspension of meetings of the JEEC is the continuous and unprecedented violation by Israel of the State of Palestine's environment. Israel has violated most parts of Article 12 of Annex I to the Oslo I Accord on environment protection.

1.4.2 Specific issues arising from the relationship with Israel

The State of Palestine faces unusual challenges due to its relationship with Israel, the occupying power. As aforementioned, Israel's occupation of the State of Palestine and the continuous growth of the Israeli Illegal Settlement Regime and activities of settlers in the West Bank, including East Jerusalem, heavily pollutes and destroys the natural environment. In 2011, there were around 541,824 illegal Israeli settlers living in the State of Palestine emitting around 5,798 Gg CO_2eq. These emissions are higher than the total net global warming potential (GWP) weighted emissions of the State of Palestine. These emissions have not been added to the State of Palestine's GHGI as the country has no direct control over the activities even though they are being undertaken illegally on Occupied Palestinian Territory.

The State of Palestine is almost entirely dependent on imported energy supplies, specifically electricity and oil products. Political and logistical factors dictate that nearly all of these supplies at present come from Israel. Almost all of the electricity for the West Bank, including East Jerusalem, is supplied from power stations in Israel where associated GHG (GHG) emissions reside. The only indigenous resources are small-scale solar water heating and some new wind-energy projects. However, the State of Palestine is in the process of developing the first large-scale electricity generation project, which is to be established in Jenin and will result in the availability of an additional 450 MW of generation capacity. This new generation capacity will cover 50% of total Palestinian electricity demand up until around 2020. The situation in the Gaza Strip is slightly different, as 30% of its electricity is supplied by the Gaza Power Plant (GPP). Despite the political situation, the State of Palestine's energy needs have continued to grow quite rapidly, due to population growth and some economic development.[21]

Additionally, due to Israel's illegal policies, the West Bank including East Jerusalem and the Gaza Strip are fragmented into two distinct geographical zones with divergent economic characteristics. The West Bank, where most Palestinian economic activity and a majority of the population are located, is landlocked and the Gaza Strip is under siege. In addition, the State of Palestine does not have control of its own borders in either area and needs in relation to climate change differ between the two areas adding complication to an already complex situation.

Finally, the Annexation and Expansion Wall and the blockade of the Gaza Strip have severely worsened Palestinian life (see Section 1.2). The Wall has reduced the access of Palestinians living in communities located behind the Wall to workplaces and essential services. They must obtain permits or "prior coordination" and pass through checkpoints in the Wall in order to continue living in their own homes and to maintain family and social relations with the rest of the West Bank. The access of service providers to these communities, including ambulances and fire brigades, has been impaired[22]. Consequently, the Israel's occupation has made information and network sharing at a national level very difficult. Flow of information, cooperation and coordination between staff members that work on climate change in both the West Bank and Gaza is jeopardized by road blocks, check points and the lack of possibility to move freely between both areas. Setting up meetings to discuss and plan climate change-related issues or face-to-face training is always subject to change and delays due to Israel's

[20] UNEP (2003) Desk study on the environment in the Occupied Palestinian Territories. www.unep.org/download_file.multilingual.asp?FileID=105
[21] The World Bank (2007) Sustainable Development Department (MNSSD) Middle East and North Africa Region, West Bank and Gaza Energy Sector Review - Report No. 39695-GZ, 2007. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2007/08/01/000020953_20070801113123/Rendered/PDF/396950GZ0Energ1white0cover01PUBLIC1.pdf
[22] OCHA (2013) Humanitarian impact of the barrier. https://www.ochaopt.org/documents/ocha_opt_barrier_factsheet_july_2013_english.pdf

control over mobility. Impacts on information flow undoubtedly affect the quality of final outputs and hinders the State of Palestine's true potential to tackle climate change effectively.

Hence, the big challenge are the constraints imposed by Israel's policies and actions on the ability of the Palestinian Government to operate and develop its systems.[23] This means that the Palestinian Government currently has limited power to address key issues in relation to fuel security and to climate change.

1.5 Population

The State of Palestine's population increased from 1.5 million in 1980 to 4.0 million in 2010. It is expected that the population will reach 8.9 million by 2050.

Table 7: Population size of Palestine by sex, 1980-2050[24]

Year	Population size (thousands)		
	Males	**Females**	**Total**
1980	763	747	1,510
1985	890	870	1,759
1990	1,053	1,028	2,081
1995	1,317	1,282	2,598
2000	1,625	1,579	3,205
2005	1,806	1,754	3,560
2010	2,037	1,976	4,013
2015*	2,308	2,240	4,549
2020*	2,608	2,532	5,140
2025*	2,926	2,842	5,769
2030*	3,251	3,159	6,410
2035*	3,575	3,476	7,051
2040*	3,894	3,788	7,681
2045*	4,207	4,094	8,301
2050*	4,513	4,394	8,906

* Projections (medium variant)

The growth rate of the State of Palestine's population increased from 3.06 % for the period 1980-1985 to 4.44 % for the period 1990-1995. It then decreased to reach 2.10 % for the period 2000-2005, only to increase subsequently and reach 2.40 % by 2010. It is projected that the State of Palestine's population-growth rate will start to decrease after 2015 and will reach 1.41 % by 2050.[25]

It is important to note that many Palestinians live as refugees or abroad. Nearly one-third of the registered Palestine refugees, more than 1.5 million, live in 58 recognized Palestinian refugee camps in Jordan, Lebanon, the Syrian Arab Republic, the Gaza Strip and the West Bank, including East Jerusalem.[26] There are also Palestinians living in Israel (Occupied Palestinian Territories since 1948) and diaspora in foreign and Arab countries, who numbered around 6,850,000 people in 2010.[27]

[23] The World Bank (2007) Sustainable Development Department (MNSSD) Middle East and North Africa Region, West Bank and Gaza Energy Sector Review - Report No. 39695-GZ, 2007. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2007/08/01/000020953_20070801113123/Rendered/PDF/396950GZ0Energ1white0cover01PUBLIC1.pdf
[24] United Nations (2013) World Population Prospects: The 2012 Revision. http://esa.un.org/unpd/wpp/unpp/panel_indicators.htm
[25] State of Palestine UN population data : http://www.escwa.org.lb/popin/members/palestine.pdf
[26] UNRWA (2016) Palestine Refugees. http://www.unrwa.org/palestine-refugees
[27] PCBS (2010) Estimated Number of Palestinians in the World by Country of Residence. http://www.pcbs.gov.ps/Portals/_Rainbow/Documents/PalDis-POPUL-2010E.htm

1.6 Economy

Against the backdrop of a challenging political situation, where steps required by the international community have not materialized, Israel continues to impose constraints on the movement of people and goods. The ongoing occupation also prevents any restoration of business confidence and investment. Israel maintains its blockade of Gaza, with ever increasing restrictions on crossing points, and constrains the movement of goods and people both within the State of Palestine and to other countries. Israel also continues to destroy Palestinian homes and businesses, as well as seize and deny access to their natural resources. These practices undermine efforts to build a strong economy and achieve fiscal independence.[28]

The State of Palestine economic performance is declining, reflected in a low growth rate, increasing unemployment and increasing poverty, inadequate investment, and a trade deficit. Israel's policies and practices are the dominant and proximal factors driving this prolonged economic crisis.

Economic indicators show major fluctuations in economic growth. Compared to 2010, growth in GDP was 12.2% in 2011. However, growth in GDP declined to 5.9% in 2012. The 2011 rise in GDP was propelled by a growth rate of 17.63 % in the Gaza Strip, offset by a lower rate of 10.4% in the West Bank. This growth was predominantly in the service sector, rather than the more sustainable production sectors. The declining growth rate is attributable primarily to volatility in external financial support and plummeting private investment.

The trade deficit climbed in 2012 to almost 51.3% of GDP (Palestine Monetary Authority (PMA), 2012 Annual Report). This demonstrates the vulnerability of the State of Palestine's economy to external economies, particularly that of Israel. Ministry of Finance (MoF) projections indicate that declines in growth of GDP will continue if the political situation remains unaltered. Growth in GDP dropped to 1.5% in 2013. Although figures have not been published yet for subsequent years, they are expected to be 2%, 1.5% and 1.0% in 2014, 2015 and 2016 respectively.

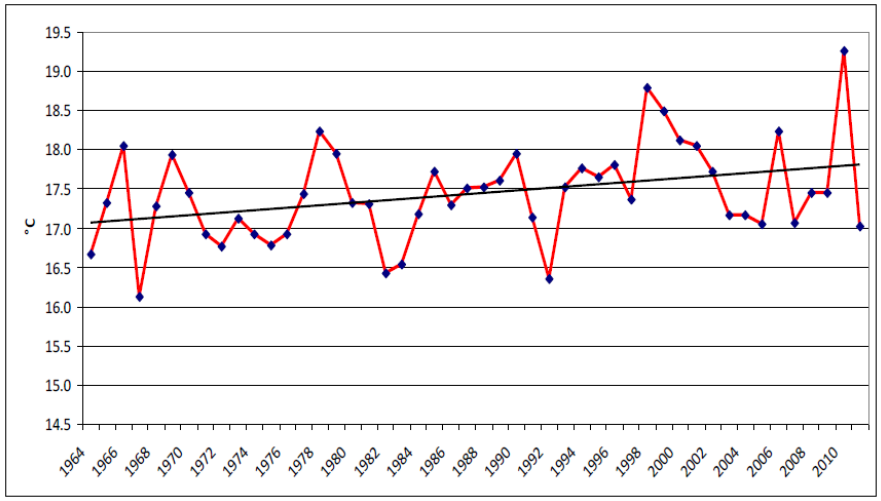
1.7 Climate

1.7.1 Temperature

The State of Palestine is situated in the Middle East, a region that generally experiences four months of hot dry summer weather and a short winter with rain from November to March. The climate in the West Bank can be characterized as hot and dry during the summer and cool and wet in winter, the central highlands have occasional frost, snow and hail, the Jordan Valley is warm and very dry in the south, while the coastal Gaza Strip is more temperate even though it borders the desert. The mean summer temperatures range from 30ºC in Jericho through 25ºC in Gaza to 22ºC in Hebron, which is 850 metres above sea level. The mean temperatures range in winter from 13ºC in Jericho and Gaza to 7ºC in Hebron. Figure 4 shows annual variability in mean annual temperature for Jerusalem from 1964 to 2011. The highest recorded mean annual temperature over this period was 19.3ºC in 2010 and the lowest was 16.1ºC in 1967.

[28] Ministerial committee for the Reconstruction of Gaza (2015) Detailed Needs Assessment (DNA) and Recovery Framework for Gaza Reconstruction. http://www.lacs.ps/documentsShow.aspx?ATT_ID=21974

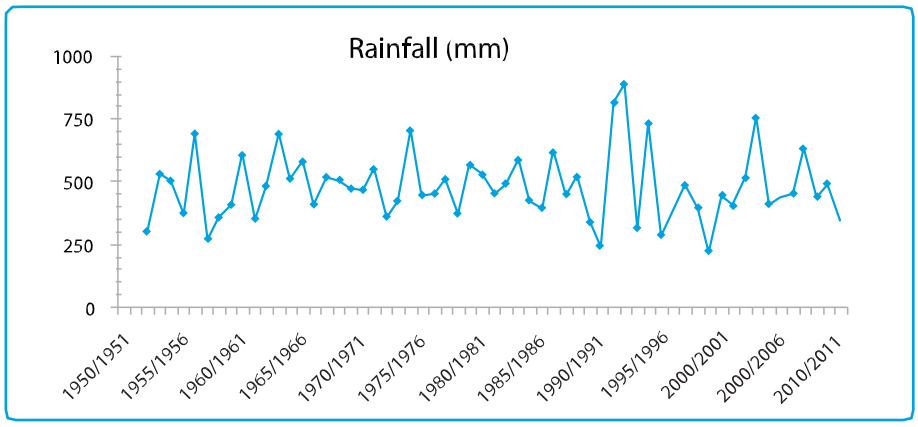
Figure 4: Jerusalem, mean annual temperature (1964-2011)[29]



1.7.2 Rainfall

The climate in the State of Palestine varies from semi-arid in the west to extremely arid in the east and southeast. The mean annual rainfall in the West Bank varies from about 650 millimeters (mm) in the west to less than 100mm in the east; the long-term annual average is about 454mm (Figure 5). The average annual rainfall for the year 2010/2011 for the entire West Bank was about 347mm; figures for 2011-2015 are provided in Table 8. The long-term average annual rainfall for the Gaza Strip is 372.1mm. Rainfall is unevenly distributed yet varies considerably by governorates from the North to the South.

Figure 5: Average annual rainfall: West Bank[30]



During the season 2010-2011, rainfall in the Gaza Strip was classified as low (225mm) compared with the long-term annual average (Figure 6); figures for 2011-2015 are provided in Table 8.

[29] Richard, M. and Issac, J. (2012) Analysis of climatic variability and its environmental impacts across the occupied Palestinian territory. Applied Research Institute – Jerusalem Water and Environment Research Department, 20pp. http://www.arij.org/files/admin/specialreports/Climate%20change%20analysis%20_PDF.pdf

[30] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf

Figure 6: Averages annual rainfall: Gaza Strip[31]

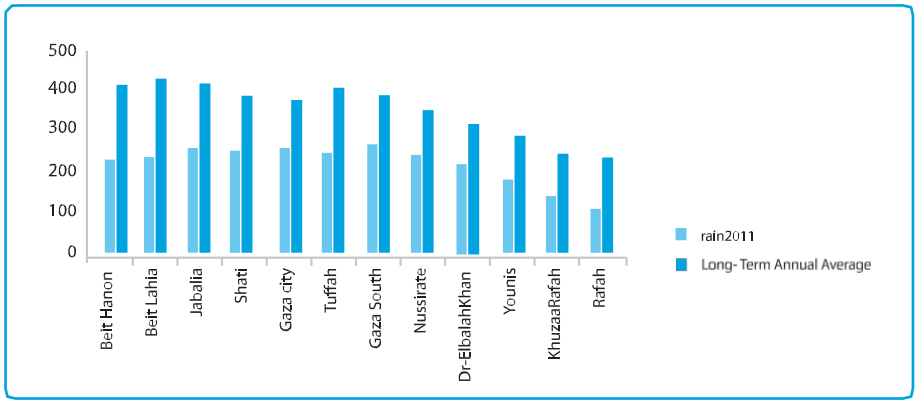


Table 8: Average annual rainfall in Palestine 2011-2015[32]

Year	West Bank (mm)	Gaza Strip (mm)
2011-2012	573	406
2012-2013	545	273.5
2013-2014	318	401
2014-2015	528	611.5

Based on rainfall figures for the hydrological year 2010/2011, the total water volumes for the West Bank and the Gaza Strip were 2,390MCM and 81MCM, respectively. The 2010/2011 season average recharge for the three West Bank ground water basins was estimated at 598MCM. This recharge quantity was calculated as follows: about 153MCM received as a net recharge to the Eastern Basin, around 311MCM to the Western Basin and around 134MCM to the North-eastern Basin. Meanwhile, the groundwater recharge in the Gaza Strip's Coastal Aquifer was about 33MCM.[33]

1.8 Water resources

1.8.1 Overall

Water is the most prevalent issue on the State of Palestine's environmental agenda, while access to water is also among the most contentious points in the negotiations with Israel. Following the 1967 occupation, Israel has controlled all shared water resources, including surface and groundwater, and has utilized more than 85% of these resources, leaving only 15% for the State of Palestine's use.[34]

As such, the Israeli occupation strongly influences the State of Palestine's water situation, both in terms of access to available water resources, and by limiting the Palestinian Government's capacities to actively improve the situation (e.g. to construct large scale dams and develop water storage reservoirs for harvesting rainfall). Under the Oslo I and II Accords (1993; 1995) both parties agreed on some interim arrangements regarding water, however, long-term solutions were deferred until the completion of Final Status Negotiations (FSN). The FSN were planned to be completed by 1998 but these

[31] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf
[32] Ministry of Agriculture (2016) pers.comm.
[33] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf
[34] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf

discussions never took place. Meanwhile, Palestinians in the West Bank are tied to increasingly outdated allocations of water. In the Gaza Strip, the issue is just as pressing, but is quite different. The challenge there is to supplement and or replace existing sources in order to reduce the pressure on the Coastal Aquifer, which is in considerable danger of irreversible damage.[35]

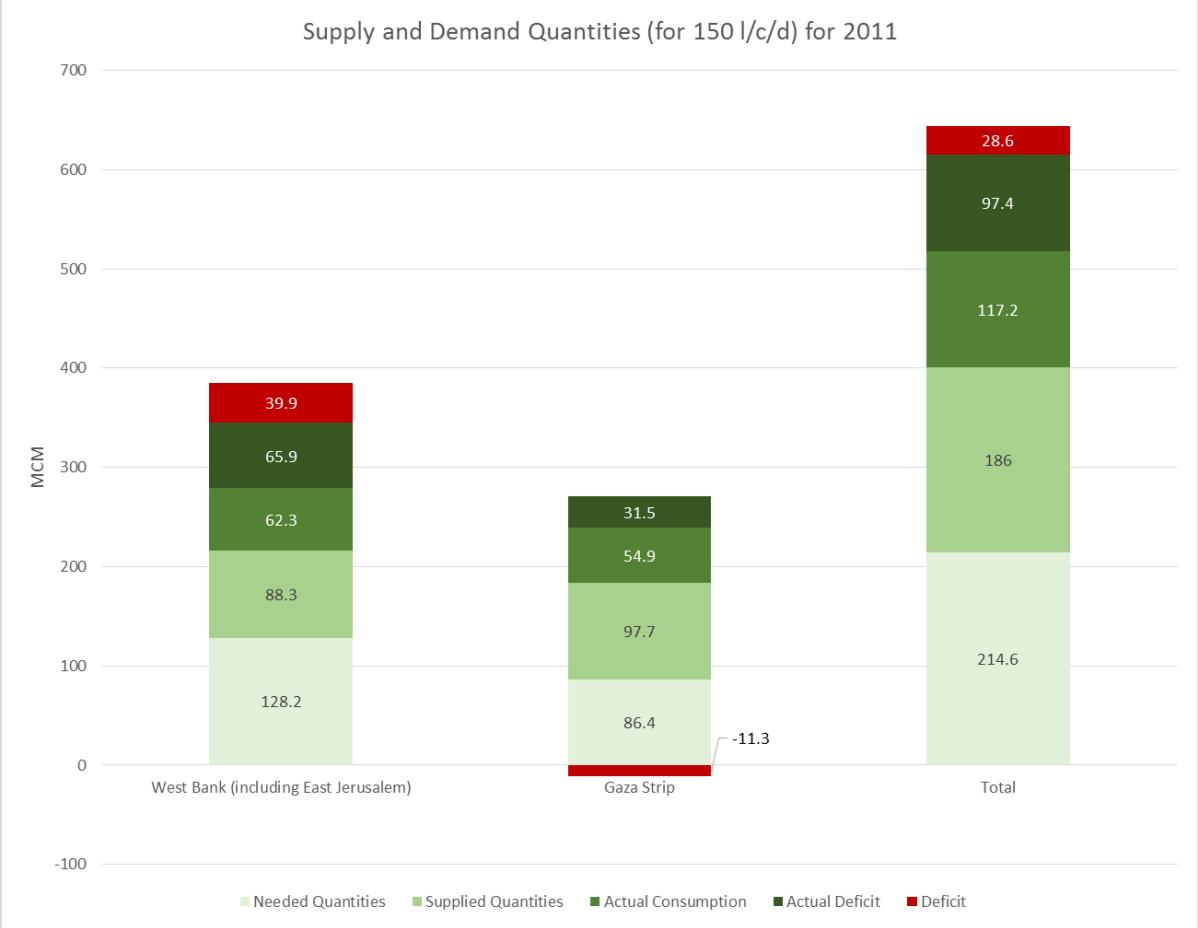
The Gaza Strip and the West Bank rely on groundwater for more than 90-95% of their water needs, as the State of Palestine is denied access to the only permanent river, the Jordan River. In the Gaza Strip, scarcity and overuse result in the intrusion of seawater into the Coastal Aquifer and a consequent deterioration in water quality. The West Bank suffers from the uneven distribution of water between the State of Palestine, Israeli settlements and Israel. The wastewater treatment plants in the State of Palestine are inadequate to serve the amount of wastewater being generated, with 58% of generated wastewater being discharged without treatment to the environment causing environmental degradation. Hence, groundwater quality is threatened and public health is endangered. Pressures on water availability include population growth, growth in agricultural and industrial production, as well as general economic development, which continue to put a strain on limited water resources, both in terms of water quality and quantity.[36]

Due to the points mentioned above, the State of Palestine is among the countries with the scarcest renewable water resources per capita, mainly due to Israel's control. Average domestic water consumption is only 72 litres per capita per day (l/c/d) in the West Bank, and 96l/c/d in the Gaza Strip with water quality much below international standards. This is far less than the per capita water resources available in other countries in the Middle East and elsewhere. Limitations on availability of water resources constrain economic development, increase running costs and cause health problems. More than half of the available groundwater is used for domestic water supply, severely limiting the available volume for irrigated agriculture and industry.

The Figure 7 below shows that the water resources needed to provide a per capita supply rate of 150l/c/d (based on the World Health Organization, WHO, standard) in the West Bank are almost 40 million cubic meter (MCM) more than the quantity currently available. Moreover, when losses in supply are also taken into account, the gap (deficit) increases to almost 66MCM[37]. It is important to note that these are domestic water demands.

[35] World Bank (2007) West Bank and Gaza Water Sector Update.
[36] ARCADIS, IEEP, ERM, Metroeconomica, Ecologic, Ecologic Institute, Palestine Wildlife Society (2011) Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection. http://www.enpi-info.eu/library/sites/default/files/attachments/OPT-ENPI%20Benefit%20Assessment.pdf
[37] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf

Figure 7: Supply and demand quantities for domestic purposes (for 150l/c/d) for 2011[38]



1.8.2 Groundwater

Groundwater is the main source of water for Palestinians in the State of Palestine and provides more than 90-95% of all water supplies. The main aquifer systems are comprised of several deep-seated rock formations from the Lower Cretaceous to the recent age. The spatial and vertical hydro-geological variety of the mountain aquifers in the West Bank determines the quantity, quality, and extraction cost of groundwater, which differ greatly within this relatively small area. The system is divided into four units; three units in the West Bank and one in the Gaza Strip. For the descriptions below, only the Palestinian parts of the shared aquifers are considered when discussing sustainable yield and abstraction. If Israel's abstraction within the West Bank is considered, then the sustainable yield is comparable but not equal to long-term average recharge[39].

The Western Aquifer Basin: This is the largest basin and the most important among the West Bank aquifer basins. It has an annual yield ranging from 362-400MCM per year. However, this basin is heavily exploited by Israel at a variable rate of 340-430MCM per year and in some years reaches more than 520MCM per year. In contrast, in 2011, the State of Palestine's annual utilization was about 25MCM from wells. The main aquifer system in this basin is comprised of the Upper and Lower Cenomanian Aquifers.

[38] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf
[39] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf

The North-Eastern Aquifer Basin: Most of this basin's recharge areas are located within the West Bank boundaries and it has an annual yield of 100-145MCM. Israel exploits the aquifer at a rate of 103MCM per year; most of this quantity taken from springs in the Galbou' Area. In 2011, the State of Palestine's annual use was only 20MCM from wells and springs, mainly from the shallow Eocene Aquifer. The aquifer system in this basin includes the shallow Eocene Aquifer, and Upper and Lower Cenomanian Aquifers.

Eastern Aquifer Basin: The basin is divided into three main sub-aquifers, namely the Mountainous Heights, North-eastern Tip and Jordan Valley. The annual yield of this basin varies from 145-185MCM. However, Israel exploits the aquifer at a rate of 50MCM per year from wells and a further 100MCM per year from Dead Sea springs that it controls. In contrast, in 2011, the State of Palestine utilized about 42MCM per year from groundwater wells and springs.

Coastal Aquifer for Gaza: The Coastal Aquifer is the only source of water in the Gaza Strip, with the thickness of water bearing strata ranging between several meters in the east and southeast to about 120-150 meters (m) in the western regions and along the coast. The aquifer consists mainly of sand, gravel and sandstone (Kurkar) intercalated by clay and silt. A hard and non-productive layer of clay and marl with low permeability (Sakia Formation), situated below the Coastal Aquifer, is about 800-1000m thick. The yearly recharge volume for this limited aquifer is in the range of 55-60MCM[40].

1.8.3 Surface water

1.8.3.1 Jordan River

The Jordan River is one of the main rivers in the region, and the only permanent river in the West Bank and in the State of Palestine. It flows from north to south, from an altitude of 2,200m above sea level to end at the Dead Sea at an altitude of 426m below sea level[41]. The Jordan River is shared by five countries: the State of Palestine, Jordan, Syria, Lebanon and Israel, with the latter using most of the water despite the State of Palestine having equal rights to the water. Israel denies Palestinians' right of access to the Jordan River. The Jordan River flows into Lake Tiberius and continues south to join with the Yarmouk River at the Yarmouk Triangle, then into the Dead Sea. Historically, the quantity of water flowing into the Lower Jordan River and discharging into the Dead Sea has been estimated as 1300MCM per year. The volume of water has decreased dramatically during the past six decades and is presently no more than 262MCM per year[42]. This huge reduction in flow is mainly due to the diversion of more than 500MCM per year by Israel through the National Israel Water Carrier that extends south to the Negev, in addition to the construction of many dams upstream. Moreover, natural factors, such as evaporation, also have an adverse impact on the river flow. Furthermore, the Jordan River is threatened by the discharge of large quantities of untreated wastewater from the Israeli Illegal Settlement Regime located along the south of Lake Tiberius[43].

1.8.3.2 Wadis

Runoff water flowing in wadis during the rainy season forms an important potential source of water. The long-term average annual flow of flood water through wadis in the West Bank is estimated at about 165MCM per year. During the 2010/2011 season, the average flow reached 131MCM per year. The West Bank wadis are classified by the direction of flow, as eastern (i.e. flowing towards the Jordan Valley and the Dead Sea) and western (i.e. flowing towards the Mediterranean). About 33 major surface catchments are recognized in the West Bank.

In the Gaza Strip, the main Wadi is Wadi Gaza, which originates from the eastern border where Israel traps the natural flow for irrigation purposes. This action dries the Wadi except in very wet years. Due to the flat topography in the Gaza Strip, storing and using any remaining surface-water resources is very limited. Surface-water harvesting of wadis is still not much developed, despite significant interest. The required investments are high and in addition Israel's occupation imposes severe restrictions on dam-construction permits.

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[40] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf
[41] World Bank (2014) Red Sea- Dea Sea Water Conveyance Study Environment and Social Assessment. http://siteresources.worldbank.org/EXTREDSEADEADSEA/Resources/5174616-1416839444345/ESA_ES_Mar_2014_English.pdf
[42] World Bank (2014) Red Sea- Dea Sea Water Conveyance Study Environment and Social Assessment. http://siteresources.worldbank.org/EXTREDSEADEADSEA/Resources/5174616-1416839444345/ESA_ES_Mar_2014_English.pdf
[43] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf

1.8.4 Coastal systems

The water situation in the Gaza Strip is much worse than in the West Bank. The Coastal Aquifer in the Gaza Strip receives an annual average recharge of 50-60MCM per year, mainly from rainfall, while the annual extraction rate of this aquifer complex is estimated at about 178.8MCM. These unsustainably high rates of extraction have led to lowering of the groundwater level, the gradual intrusion of seawater and upwelling of saline groundwater. Tests have indicated high salinity levels of more than 1,500 milligrams per liter (mg\l) of chloride, making significant parts of the aquifer unsuitable for drinking water, domestic applications and for many irrigated crops. The shallow aquifer complex is also very vulnerable to ongoing and serious pollution from agriculture, solid waste and wastewater. In fact, it is believed that the Gaza Aquifer has already passed the point of no return and needs to be regenerated before it can be used sustainably again. This leaves the population of the Gaza Strip without a reliable and affordable water source[44]. In fact, the Coastal Aquifer is projected to be depleted by next year and nitrates and other pollutants have made 95% of the Gaza Strip's water unpotable[45] (for further information about the Coastal Aquifer see Section 1.8.2).

1.9 Nature and biodiversity

The State of Palestine is located in a unique position between different biogeographic regions: the European, Asian and African continents, the Mediterranean and the Red Sea. It is divided into five agro-ecological zones (the Jordan Valley, the Eastern Slopes, the Central Highlands, the Semi-coastal Plain, and the Coastal Plain), which each have a very different climate. As a result of the country's biogeography and diverse climate, it has considerable importance for biodiversity. The natural habitats are exceptionally important because of their: unique intrinsic value; 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. As a historic center of crop diversity and cultivation, the State of Palestine is the birthplace of many essential crops, such as wheat, barley, grapevines, olives, onions, and pulses.

Over time, the State of Palestine's environment has suffered considerable degradation. Key pressures affecting natural habitats in the State of Palestine include: unplanned urban expansion, overgrazing, over-exploitation, deforestation and unplanned forestry activities, desertification and drought, soil erosion, hunting, invasive alien species, pollution, and contamination. Israel's occupation makes a substantial negative contribution directly to these pressures, including from: the Israeli Illegal Settlement Regime, the Annexation and Expansion Wall, bypass roads and military outposts; the destruction of infrastructure; seizure of agricultural land; and deforestation.[46] In addition, Israel's wars on the Gaza Strip between 2008 and 2014 resulted in unprecedented damage to the environment. Furthermore, Israel's occupation limits the State of Palestine's ability to regulate land use, properly monitor the status of the environment, and enforce environmental protection measures.

1.10 Social services

The Palestinian Government's Ministry of Social Affairs aims to provide social protection to poor and marginalized groups through providing:

- Cash transfers to severely impoverished families
- Food packages to families among the poorest 60% of Palestinian families
- Health insurance for people living below the extreme poverty line
- Social care, rehabilitation and protection to physically disabled citizens and the elderly living below the extreme poverty line

[44] Palestinian Water Authority (2011) Annual status report on water resources, water supply and wastewater in the occupied State of Palestine. http://www.pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf
[45] Ministerial committee for the Reconstruction of Gaza (2015) Detailed Needs Assessment (DNA) and Recovery Framework for Gaza Reconstruction. http://www.lacs.ps/documentsShow.aspx?ATT_ID=21974
[46] ARCADIS, IEEP, ERM, Metroeconomica, Ecologic, Ecologic Institute, Palestine Wildlife Society (2011) Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection. http://www.enpi-info.eu/library/sites/default/files/attachments/OPT-ENPI%20Benefit%20Assessment.pdf

- Training and funding to small-medium enterprises (SME) run by economically deprived households, the disabled, female-headed families, and impoverished new graduates from universities and other tertiary education establishments.

There continues to be a high level of poverty, particularly in the Gaza Strip. According to monthly consumption patterns, 25.8% of people live in poverty in the State of Palestine (West Bank 17.8%, Gaza Strip 38.8%). This places a burden on social protection programs and demand for basic social service delivery. Poverty is closely linked to unemployment. In the last quarter of 2013, the unemployment rate among the labour force was 25.2% (38.5% in Gaza Strip, and 18.2 % West Bank)[47].

The most vulnerable population groups in the State of Palestine include: those who have become homeless and/or disabled due to Israeli aggressions; farmers and Bedouins; refugees; people in the Gaza Strip who were displaced as a result of three wars in six years; and martyrs' and prisoners' families.

1.11 Health care

Health services are provided through the public sector, the NGO sector, the private sector and the United Nations Relief and Works Agency (UNRWA). The Palestinian Government's Ministry of Health (MOH) provides health services to Palestinians under its jurisdiction. Additionally, the Government's insurance plan is the principal provider of health insurance. Public sector spending represents about 32% of health care expenditure in the State of Palestine. UNRWA has had jurisdiction over the social services of Palestinian refugees, the organization provides free health services to eligible Palestinians living in the West Bank and in the Gaza Strip provided that they are registered as refugees[48]. The UNRWA finances about 24% of all health care spending in the State of Palestine.

A World Bank survey found that 11.7% of Palestinians used NGOs most frequently for their health needs. Palestinians are most likely to visit NGOs when they require mental-health counselling, physical therapy and rehabilitation, and medical training. They are least likely to use NGOs for emergency care, routine check-ups, and maternity and paediatric needs. The private health care space has grown in recent years with the advent of private hospitals, pharmacies, laboratories, and rehabilitation centers. Some private health insurance programs have been established but have limited popularity. Private expenditure comprises roughly 37% of all spending on health care in the Gaza Strip and the West Bank.

The under-five mortality rate was 21.7 per 1,000 live births[49] in 2014. For other ages, the leading causes of death in general are cardiovascular diseases, cancer, cerebrovascular diseases and diabetes; reflecting the high prevalence of non-communicable diseases and their risk factors. In 2013, average life expectancy in the State of Palestine was 72.5 years and, in 2008, was 73 years for women and 70 years for men. In contrast, it was 84 years for women and 80 years for men[50] in Israel.

1.12 Education System

In the Palestinian education system, compulsory basic education includes Grades 1 to 10. Secondary education (general secondary education and a few vocational secondary schools) covers Grades 11 and 12. There are 11 universities and 11 technical colleges that provide tertiary education in the State of Palestine, all of which mainly offer four-year courses. Additionally, there are 19 community colleges that mainly offer two-year diploma courses in technical and commercial specializations. The illiteracy rate among people aged 15-24 was 0.7% for men and 0.6% for women between 2008 and 2012[51].

The Ministry of Education and Higher Education (MOEHE) has responsibility for the whole education sector from pre-primary to higher education, as well as for recruiting and training teachers. The MOEHE is also in charge of managing governmental educational institutions, and supervising private educational institutions and institutions run by UNRWA. UNRWA provides basic education to all registered refugee children free of charge up to around the age of 15 (9th grade). Scientific research is advocated by the MOEHE. All universities include research as one of their objectives and most have a

[47] State of Palestine (2014). National Development Plant 2014-16. http://www.mopad.pna.ps/en/images/PDFs/Palestine%20State_final.pdf
[48] WHO (2013), Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan. http://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_INF3-en.pdf
[49] PCBS (2015) The Palestinian Central Bureau of Statistics (PCBS) and the Ministry of Health (MOH) Issue a Press Release on the Occasion of International Health Day 07/04/2015. http://pcbs.gov.ps/portals/_pcbs/PressRelease/Press_En_IntHDy2015E.pdf
[50] WHO. WHO leaders study health situation in Israel and the Occupied Palestinian Territory.http://www.who.int/dg/health_situation_20130611/en/
[51] UNICEF. At a glance: State of Palestine. http://www.unicef.org/infobycountry/oPt_statistics.html

scientific research Deanship. On the other hand little funding is provided for scientific research by the MOEHE and local universities and most funding is through regional, bilateral and international projects. In terms of research outputs, including publication citations and impact factors, the State of Palestine is better than many of the Arab countries.[52]

The Education Sector Strategy 2011-2013 is built on four core pillars: enrolment, quality of education, management, and linkage with the needs of the market and society. The university education consists of four years' college education to obtain a bachelor's degree and an additional two years for a master's degree. The majority of universities are non-profit institutions. They combine fund-raising with funding received from the Palestinian Government. However, the system heavily depends on student fees, which represent 60% of universities' operating costs. The universities' environmental science and engineering programs enhance capacity building, provide studies and applied research, as well as sponsor workshops, conferences and awareness programs in environmental subjects. There are three bachelor-degree environmental-engineering programs and six master-degree programs in the State of Palestine in the areas of water, energy, environment, and sustainability.

1.13 Energy sector

In the State of Palestine, energy sources comprise: petroleum and natural gas derivatives; electricity; and renewable energy. Scarcity of indigenous energy sources and an inability to exploit those that do exist means that the State of Palestine is largely dependent on energy imports from Israel, with the exception of renewable energy, which comprised 18.5% of the country's energy consumption in 2012.

Gas and petroleum derivatives fulfil 51% of local energy consumption, and are used mostly to fuel: vehicles, heating and cooling systems, workshops, and factories. Israel has been the only source of petroleum and gas derivatives. The State of Palestine lacks adequate local storage facilities. Local market needs are imported on an almost daily basis, creating crises in the distribution system, as well as an inability to meet local demand.

In 2011, electricity comprised approximately 25% of the total energy consumed locally. The State of Palestine is largely dependent for its electricity on importation from Israel. In 2008: electricity imported from Israel constituted 87.7% of total electricity consumption; domestic electricity generation by the Gaza Electricity Generation Plant comprised 9.7% of total electricity consumption; and the remainder was imported from neighbouring countries (Jordan and Egypt). In late 2006, the Palestinian Energy Authority and Natural Resources Authority (PENRA) installed a 22kV medium pressure supply line with a 17MW capacity between the Palestinian Rafah and the Egyptian Rafah cities. In early 2008, the Palestinian Energy Authority also installed a 20MW 33kV medium pressure supply line to supply the Jericho governorate with electricity from Jordan. In the West Bank, about 49% of the electricity is utilized by households, 30% by commercial establishments, and 20% by industry, agriculture, street lightning, water pumps and others.[53]

1.14 Agriculture

The State of Palestine's location provides a beneficial range of climatic zones that are favourable to agriculture, with coastal plains on the Mediterranean Sea, mountains and land below sea-level. Agriculture plays an important role in the State of Palestine's economy in terms of its contribution to GDP, employment, trade, and food security. In 2011, agriculture provided about 5.4% of GDP, and 12% of employment. In addition, domestic agricultural production provides about 78% of food consumed locally and, hence, is vital role to the country's food security.

The State of Palestine has approximately 31% agricultural land cover; 91% in the West Bank and 9% in the Gaza Strip. The rain-fed area constitutes 86% of cultivated land; 97% in the West Bank and 3% in Gaza. The irrigated area comprises 14% of the total arable land. Between 2004 and 2008, the area of cultivated fruit trees, vegetables and field crops rose by 1.6%, 3.9% and 0.8% respectively. However, while production of vegetables and field crops increased by 18% and 11% respectively, fruit production dropped by 21%. During the same reporting period, the number of cattle rose by 1.8% and layer-chickens by 7.2%. As a consequence, cattle-meat production rose by 0.4% and milk and eggs by 71.7%

[52] Talal Shahwan (2015). Blog in Arabic. http://www.birzeit.edu/ar/blogs
[53] State of Palestine. Palestinian National Plan 2011-13; Energy sector strategy. www.mopad.pna.ps/secstra/Sector%20Strategy%20Summary%20-%20Energy.pdf

and 7.3% respectively. In contrast, the number of goats, sheep and broiler chickens dropped by 19.2%, 15.1% and 17.4% respectively and meat production of sheep, goats, poultry and fish decreased by 16.9%, 18.9%, 17.5%, and 9.8%; honey production also declined by 32%[54].

There was a major decline in the Palestinian agricultural area from 183,000 hectares in 1996 to around 103,000 hectares in 2010. Olive-oil production also declined, as production dropped from an average of 23,000 tons per year during the period 2000–2004 to 14,000 tons per year during the period 2007–2010[55].

Regardless of its key socio-economic role, the agricultural sector faces many obstacles, as highlighted by the Agriculture Strategies 2011-2013 and 2014-2016, including Israel's repressive measures and particularly its confiscation of land and water resources[56]. Israel has restricted the import of many types of fertilizers and chemicals and the export of agricultural products resulting in extremely high production costs.

1.15 Transport

The transport infrastructure is particularly problematic. Palestinian use of roads in Area C is highly restricted by Israel and travel times can be inordinate, while use of many other roads is restricted only to public transport and to Palestinians who have special permits from Israeli authorities. The Palestinian Government has also been unable to develop roads, airports or railways in or through Area C.

Road transport is currently the only transport system, which provides opportunities for the movement of people and goods within the State of Palestine and to other countries. The paved road network in the State of Palestine extends to 2,869km. About 2,248km of these roads are in the West Bank, including 207km of roads within the Jerusalem Governorate, and about 621km in the Gaza Strip. The main roads form about 21% of the total road network, the regional roads form about 30%, while local roads form 49%. There are also other roads with a total length of 1,018km, mostly located in the West Bank, solely constructed for Israel's use, which are bypasses and roads for the Israeli Illegal Settlement Regime.

There is no linkage or free passage between the West Bank and the Gaza Strip. There is also no airport or seaport to connect with other countries. The Gaza Airport, which was opened on the 24 November 1998, was destroyed by Israel in October 2000. Similarly, the Gaza Port was destroyed by Israel in 2000[57] and Israel's continuing blockade prevents its use for movement of people and goods. These political constraints halt the development of a sound and efficient transport system in most rural areas, which makes implementation of a national transport master plan difficult. This has led to the development of projects that are neither coordinated nor in harmony with the prioritized national needs of the transport sector.

More information on the number of cars, buses or lorries on the roads, can be found in Section 2.3.1 under "Transport".

1.16 Construction sector

The construction sector is highly productive and one of the State of Palestine's key economic sectors. It is a major driver of the national economy. In 2010 contributed 11.1% of the country's GDP and is continuing to grow. In addition, construction is one of the most important sectors for employment. In 2010, the construction sector directly employed about 13.2% of the State of Palestine's labour force, plus a higher percentage indirectly in associated factories, and production and service sectors. The construction sector also activates many other sectors, including supporting industries and trading in construction materials trading. Hence, it constitutes an important element in attracting investments.

The main challenges faced by the State of Palestine's construction sector are limited project management skills, market-based factors and modern construction technologies. Local authorities are required to improve and upgrade the infrastructure, so that it can serve new buildings within the existing

[54] Ministry of Agriculture (2010) Agricultural Sector Strategy: A Shared Vision / 2011-2013. hwww.lacs.ps/documentsShow.aspx?ATT_ID=3991.
[55] United Nations Conference on Trade and Development (UNCTAD) (2015) The Besieged Palestinian Agricultural sector. http://unctad.org/en/PublicationsLibrary/gdsapp2015d1_en.pdf
[56] Ministry of Agriculture (2012) Palestinian National Agricultural Extension Strategy (PNAES) http://www.ershad.moa.pna.ps/uploads/file/Extension%20Strategy/Palestinian%20National%20Agricultural%20Extension%20Strategy.pdf
[57] Al-Sahili, K. and Abu-Eisheh, S.A. (2005) Diagnosis of Existing Transportation Systems in Palestine under the Current Political Conditions, The TRB 85th Annual Meeting, Washington DC. https://staff.najah.edu/alsahili/academic-conference/trb-85th-annual-meeting-washington-dc

urban area. There is a need to prepare master plans for the outskirts of urban areas in order to make suitable land available for construction. Existing buildings do not necessarily meet building regulations. Israel restricts construction within Area C. Hence, people are forced to build vertically within cities rather than horizontally, and this has caused rising land prices and further limited economic development in rural areas[58].

Interest in the concept of green buildings intensified after 2011. The Palestine Green Building Council (an NGO) and the Higher Green Building Council of the Engineers Association were established and the Green Buildings Guidelines[59] were developed The Palestinian Museum, once completed in 2016, is expected to become the first Leadership in Energy and Environment Design (LEED) certified building in the State of Palestine. Almost all new buildings have insulation to ensure energy conservation.

1.17 Solid waste

The amount of municipal solid waste (SW) produced in the State of Palestine was estimated to be 970.68 Gg in 2011, with organic waste constituting about 60.6%. In 2009: the daily production rate of residential SW was estimated to be about 2,321 tons; the average daily residential SW production per dwelling was 3.5 kg/day at an average rate of 0.6 kg/capita/day; based on data from the PCBS, the amount of SW produced by healthcare centers was estimated at 1,202 ton per month; and SW from industrial establishments was estimated at 787 ton per month. A SW-collection service now serves 90% of the State of Palestine's population. Hazardous-waste management is still in the early phases of development and is expected to be implemented, especially with the State of Palestine joining the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal.

The State of Palestine's limited jurisdiction and control over resources has prohibited implementation of several SW projects and construction of regional facilities, especially in Area C. Israel's practice of disposing of waste, including hazardous waste, in the State of Palestine has further aggravated the health and environmental impacts arising from SW[60].

In order to address the challenge of unsanitary and illegal dumping of waste, a number of sanitary landfills have been constructed. Zehrat el Finjan, Jericho and Alminyeh were opened in the West Bank in 2007, 2007 and 2014 respectively. Johr al Deek, Deir el Balah and Sofa were opened in the Gaza Strip in 1987, 1996 and 1998 respectively[61]. In the West Bank, the design of Ramallah sanitary landfill (Rammon) has been completed. Preparations are being made for a new sanitary landfill for the middle and southern part of the Gaza Strip and tender documents were released in April 2016.

There is very limited recycling in the State of Palestine. In 2010, about 6,400 tons was recycled, which is equivalent to less than 1% of all SW. It is thought that most of the recovered material is cardboard and hard plastic. There are no data available regarding metal. In the Gaza Strip, recycling is highly linked to the availability of raw materials, which is dependent on the blockade and Palestinians' ability to import raw materials; 20% of plastic is recycled. There are approximately 200 people in the State of Palestine who are waste pickers; recovering recyclables from disposal sites and transfer stations. The amount of material recovered by these waste pickers is unknown[62].

The National Strategy for Solid Waste Management in the Palestinian Territory (2010-2014) identified a number of challenges, including inefficient provision of primary SW collection and transport services, unsanitary disposal of SW in illegal and open dumpsites, and the need to further develop the legislative framework governing the sector[63].

1.18 Institutional arrangements

The Palestinian Government has recently established the National Committee on Climate Change (NCCC), as described in Section 1.18.1.

[58] Dmaidi, N., Dwaikat, M. and Shweiki, I. (2013) Construction contracting management obstacles in Palestine, International Journal of Construction Engineering and Management. http://article.sapub.org/10.5923.j.ijcem.20130201.03.html
[59] Green Buildings Guidelines. State of Palestine, Palestine Higher Green Building Council, Engineers Association 2013 (not available online)
[60] Palestinian National Authority (2010) National Strategy for Solid Waste Management in the Palestinian Territory 2010-2014. http://www.molg.pna.ps/studies/TheSolidWasteManagementStrategy2010-2014.pdf
[61] EMCC & UNDP. The Vision of Gaza after 20 Years. Available in Arabic only. PowerPoint Presentation.
[62] Sweepnet (2014) Country report on the solid waste management in Occupied PALESTINIAN Territories. http://environment.pna.ps/ar/files/Country%20report%20on%20the%20solid%20waste%20management.pdf
[63] EMCC & UNDP. The Vision of Gaza after 20 Years. Available in Arabic only. PowerPoint Presentation.

There is a need to increase awareness of climate change and to develop necessary competencies and technical capacities across key government institutions, such as the Environment Quality Authority (EQA), the Ministry of Finance and Planning[64], the Ministry of Agriculture (MOA), the Palestinian Water Authority (PWA), the Ministry of Transportation (MOT) and the Palestinian Energy and Natural Resources Authority (PENRA). In order to better understand these needs, the State of Palestine undertook an "Assessment of national capacities for implementing climate change adaptation and mitigation measures and development of a national capacity development program for the Palestinian Authority", as a component of the project on "Enhancing the capacities of the Palestinian Authority in mainstreaming environment and climate change"[65]. Hereafter, this will be referred to as the National Capacity Development Program (NCDP).

The NCDP highlights that the State of Palestine needs to respond to the challenges of climate change, by developing relevant Low-Emissions Climate Resilient Development Strategies (LECRDS) and policies; creating technical capacity to collect and analyse related data to monitor and address the effects of climate change on different development sectors. The aim is to improve national and local capabilities to respond and adapt to climate change through focusing on the following key activities:

- Developing a strategic and programmatic road map for Palestine to implement LECRDS and policies, as well as identify the need for implementing a climate change territorial-based approach vis-a-vis the LECRDS
- Supporting institutional and financial capacities to address the impacts of climate change
- Supporting regional, national and local approaches to climate change mitigation and adaptation
- Enhancing the resilience of the most vulnerable communities affected by climate change.[66]

The NCDP also presents information on the NCCC and proposes a new National Institutional Framework on Climate Change (NIFCC), which are described in Sections 1.18.1 and 1.18.2 respectively.

1.18.1 National Committee on Climate Change (NCCC)

The NCCC is an expert advisory committee, which supports the Palestinian Government in the implementation and evaluation of its climate policies. It advises on where attention is required with regard to risks and on GHG mitigation and adaptation needs. The NCCC, on behalf of the Palestinian Government, is responsible for preparing climate-related policies, and following decisions by the Cabinet, monitoring implementation of these policies[67]. The NCCC was heavily involved in the development of this INCR.

The NCCC's particular role is to support the Palestinian Government to:

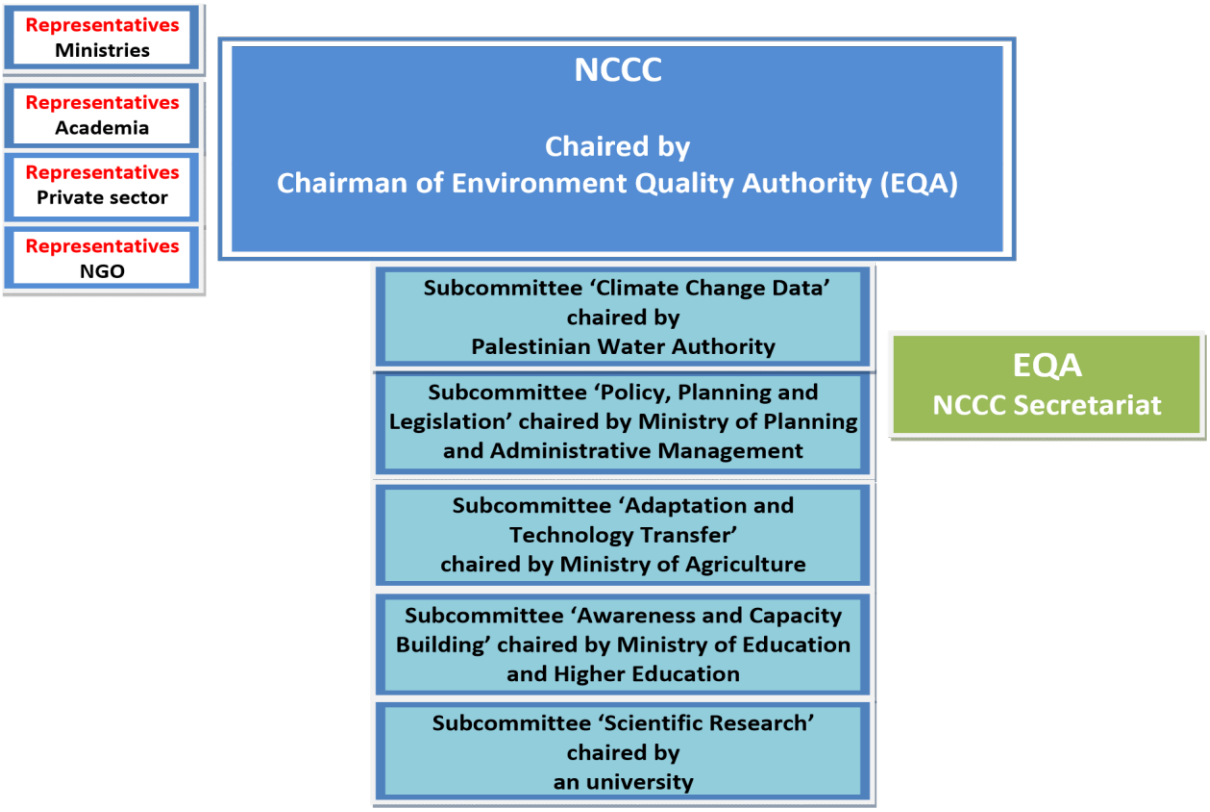
- Enhance the establishment of a scientific/technical and technological mechanism that addresses developments, impacts and potential challenges associated with climate change in the State of Palestine
- Enhance the organization of scientific and technical research to inform adaptation and mitigation programs and projects
- Ensure proper execution of the GHGI and preparation of the State of Palestine's NCs for submission to the UNFCCC through EQA, as the National Focal Point (NFP)
- Develop and monitor the implementation of the National Strategy on Climate Change and the related mitigation and adaptation programs of action, plans and policies
- Enhance research and solicit and create financing mechanisms that will facilitate and allow the State of Palestine to succeed in its endeavours in relation to climate policy
- Implement a broad communication strategy, including an awareness-raising, information and education campaign, and develop scientific and technical research and studies on climate change in the State of Palestine

[64] Formerly two Ministries: Ministry of Finance (MoF) and Ministry of Planning and Administrative Development (MoPAD)
[65] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.
[66] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.
[67] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.

- Ensure that the State of Palestine regularly participates, and is strongly represented, in the international negotiations on climate change[68].

The NCCC is chaired by EQA, which also acts as the permanent NCCC Secretariat, and comprises appointed representatives from the different sector ministries and agencies, academia, NGOs, and the private sector (see Figure 8).[69]

Figure 8: Palestinian National Committee on Climate Change (NCCC)

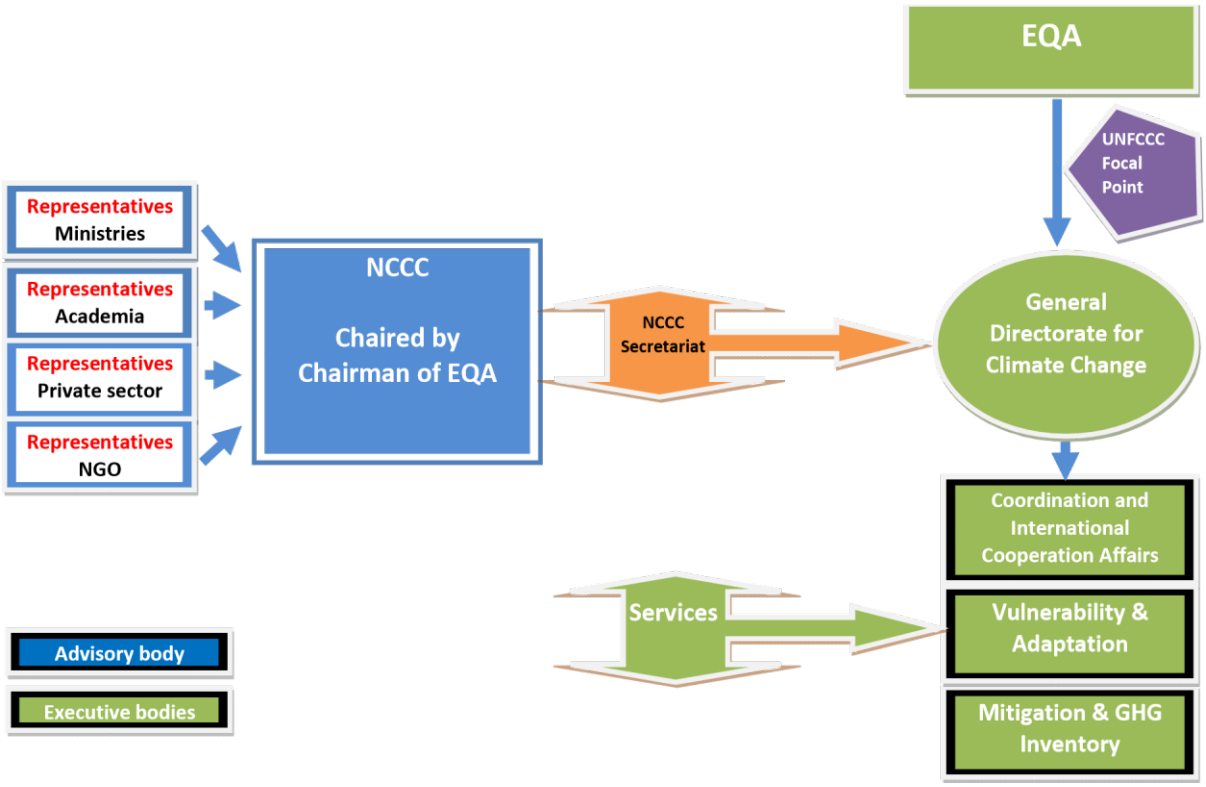


1.18.2 A National Institutional Framework for Climate Change (NIFCC)

The State of Palestine needs strong and proactive approaches to adaptation and mitigation programs and development projects in order to address climate change. There is a need for integrated, dynamic policies to deal with climate change and their success requires good governance through the adoption of a NIFCC. The NIFCC presented here (Figure 9) has not yet been developed but has been proposed as part of the NCDP[70]. The advisory body is intended to be the NCCC with the NCCC Secretariat responsible for coordination between the NCCC and the executive bodies, i.e. the ministries responsible for climate policy in Palestine, as part of their assigned mandates, including outsourcing and overseeing the implementation of related activities by local governments and service providers at national and local levels, and coordination and consultation with EQA – recognizing the lead and key coordination role of EQA in this matter.

[68] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.
[69] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.
[70] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.

Figure 9: Proposed National Institutional Framework for Climate Change in Palestine (NIFCCC)



1.18.3 Other institutional arrangements

Institutional structures have also been developed for a GHGI system (see Section 2.6).

1.19 Specific needs and concerns arising from climate change

The key needs and concerns arising from climate change relate to the State of Palestine's abilities to adapt. Development of the NAP has identified a wide range of highly vulnerable issues in relation to 12 themes/sectors: Agriculture; Coastal and marine; Energy; Food; Gender; Health; Industry; Terrestrial ecosystems; Tourism; Urban and infrastructure; Water, Waste and wastewater. These vulnerabilities are compounded by Israel's occupation, which places severe constraints on the State of Palestine's adaptive capacities as described in Chapter 4, Section 5.

Future-climate scenarios for the State of Palestine have been developed from all projections considered by IPCC AR5 (Chapter 4, Section 6 and NAP Appendix 3). Three scenarios have been selected that are representative and cover the full range of options. Temperature increases by 1.0-1.5°C by 2025 and by 2.0-4.5°C by 2090. All three scenarios suggest reduced cold periods and warmer periods, both becoming more prominent in time. Rainfall decreases by up to 30% by 2090. Risk of drought and flooding (due to the rare wettest days become more frequent) increase with increasing emissions.

The NAP has identified, prioritized and costed specific adaptation actions required to address the potential impacts posed to highly vulnerable issues by these climate change scenarios (Chapter 4, Section 7 and NAP Appendix 4). These actions seek either to reduce climate sensitivities or increase adaptive capacities and it is vital that the State of Palestine secures adequate support to implement them over the next 5-10 years.

Alongside steps to adapt to climate change, it is important that the State of Palestine plays its part in activities that mitigate GHG emissions, or controls the rate of increase of those emissions globally. While the relative merits of adaptation actions for mitigation have been taken into account in their prioritisation within the NAP, the State of Palestine's mitigation projects and plans are more specifically outlined in Chapter 3.

In order to enable the State of Palestine to implement the NAP and mitigation plans that have been prepared, including provision of necessary technologies and capacity building, it will be extremely important that fundraising is able to fulfil associated financial needs.

2 National greenhouse-gas inventory

The State of Palestine has decided to fulfil the requirements of Article 4 and 12 of the UNFCCC by creating a national GHG inventory (GHGI) and reporting on GHGs. Inventories are a valuable source of information on emissions and removals of GHGs for reporting and developing cost-effective emission-reduction policies.

This chapter presents the anthropogenic emissions by sources, and removals by sinks, of GHGs not controlled by the Montreal Protocol in the State of Palestine.

The baseline year chosen for the GHGI was 2011, as it was the most recent year with the most complete set of reliable activity data. However, the State of Palestine has gone beyond the requirement of the NC to produce a GHGI for a single year[71], and has created a GHGI with a time-series from 2006-2013. Creating a time-series has allowed the Palestinian Government to develop a greater understanding of changes in GHG emissions over time and, hence, mitigation options. This chapter presents and describes the GHGI for 2011 according to sector, and comments also on the time-series of emissions.

The GHGI was constructed using the 2006 IPCC inventory software[72] in conjunction with the methodologies and emission factors set out in the 2006 IPCC guidelines. Data was prepared for the software using a wide range of supporting sectoral "master" spreadsheets.

The GHGI covers the State of Palestine and, hence, the following geographic areas:

- West Bank including East Jerusalem
- Gaza Strip

It is important to note that emissions from the Israeli Illegal Settlement Regime, mainly in the West Bank including East Jerusalem, were not accounted for in the GHGI but have been estimated and reported separately in this INCR.

In this GHGI, the State of Palestine estimated emissions of GHGs and removals of CO_2.

The GHGs included in the GHGI are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) from the following sectors:

- Energy
- Industrial processes and product use (IPPU)
- Agriculture, forestry and other land use (AFOLU)
- Waste.

IPCC's Second Assessment Report (IPCC AR2) GWP weightings were used to calculate the global warming potential (GWP) weighted emissions of each gas. IPCC AR2 GWPs have been used to ensure reporting is consistent with the reporting requirements for non-Annex I Parties, as shown in Table 9. GWP-weighted emissions for all gases are presented in all graphs and tables in this chapter.

[71] Decision 17/CP.8 (NCR Guidelines) "Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention" from Report of the conference of the parties on its eighth session, held at new Delhi from 23 October to 1 November 2002. FCCC/CP/2002/7/Add.2 28 March 2003. UNFCCC. http://unfccc.int/resource/docs/cop8/07a02.pdf#page=2. Accessed January 2015. "Non-Annex I Parties shall estimate national GHG inventories for the year 1994 for the initial national communication or alternatively may provide data for the year 1990. For the second national communication, non-Annex I Parties shall estimate national GHG inventories for the year 2000. The least developed country Parties could estimate their national GHG inventories for years at their discretion."

[72] The software implements Tier 1 methods for calculating emissions and removals as set out in the IPCC 2006 guidelines. Pre-release version 2.15.5549.23006 was used. The creation of the GHGI revealed some errors in the original software. The IPCC helpdesk were able to correct the major problems identified, but a few problems remain.

Table 9: GWPs used (IPCC AR2)

Gas	CO_2 equivalent (IPCC AR2)
Carbon dioxide	1
Methane	21
Nitrous oxide	310

In order to present all the important aspects of the GHGI and to follow the reporting requirements of the NC guidelines, this chapter presents the following information:

- Mechanisms used to adhere to the principles of IPCC good practice
- The GHGI by sector, including time-series from 2006 to 2013
- An overview of methods, assumptions, activity data, and emission factors
- Key category analysis
- Institutional arrangements for the preparation and reporting of the GHGI
- The approach to data collection, processing and management
- Review and approval of the GHGI
- Uncertainties
- Future improvements needed.

2.1 Adhering to IPCC good practice guidance

The UNFCCC asked the IPCC to develop guidelines setting out the approaches that countries should take towards implementing "good practice" when developing a GHGI. The goal of the guidelines is to assist countries in producing inventories that are *"accurate in the sense of being neither over nor underestimates so far as can be judged, and in which uncertainties are reduced as far as practicable".* It also upholds the values that a GHGI must be transparent, consistent, comparable, complete and accurate. Palestine has applied these guiding principles in the creation of their GHGI. As this is Palestine's first NC, it has concentrated on developing a complete GHGI that is as accurate as possible. Palestine will then make incremental improvements in accuracy. Figure 10 shows the IPCC good practice principles that underpin GHGI quality.

Figure 10: The five IPCC principles of good practice underpinning GHGI quality

The State of Palestine has taken the following steps to comply with each of these overarching principles.

Transparency: The GHGI for the State of Palestine was created in a transparent and traceable way. "Master" spreadsheets in Excel were created for each sector to store and process all the data and make the necessary calculations to "gap fill" where data was missing. In order to ensure transparency, the master spreadsheets document all the assumptions made, any emission factors used, and all data sources used. Colour coding and shading was used to help traceability, for example, cells in the spreadsheet were colour coded to indicate whether the data was calculated or interpolated.

Accuracy: In an attempt to be as accurate as possible, country-specific data were used, when possible, instead of making simplified assumptions or using default data in the IPCC software. For instance, in the waste sector, the State of Palestine made an effort to gather the activity data on waste arising between 2006 and 2013, as opposed to simply multiplying population by IPCC default assumptions about waste generation/capita. Other examples of country-specific activity data were energy use, waste composition, and animal numbers. However, in some instances where data was available for one year and not others, a range of approaches were used to gap fill and extrapolate. For example, data on land use was incomplete and, hence, it was assumed the land use in 2011 applied to all other years in the GHGI. However, once more information is gathered, this data can be changed and updated in the IPCC software.

Completeness: Given that this is the State of Palestine's first GHGI, an almost complete inventory for all sectors was created.

Comparability: By using the IPCC methods, the State of Palestine's GHGI is comparable with other inventories generated using these methods. This facilitates comparison with other similar countries.

Consistency: As the State of Palestine developed a time-series for its GHGI, it ensured that the same method, methodology and assumptions were used where possible across the time-series to ensure consistency.

2.2 GHGI for 2011

The baseline year chosen for the GHGI was 2011, as it was the most recent year with the most complete set of reliable activity data.
In 2011, the State of Palestine emitted 3,226.3 Gg CO_2 eq. (3,226,300 metric tonnes CO_2 eq.) and the population was 4,168,860[73]. In turn, this meant that the country's emissions per capita were approximately 0.8 tons CO_2 eq. This population included the West Bank including East Jerusalem and the Gaza Strip. The State of Palestine's emissions per capita were significantly lower than neighbouring countries. Table 10 below provides the approximate per capita emissions of these countries in CO_2 equivalents for comparison.

Table 10: Comparison of emissions per capita (CO_2 eq.)

Country	Year	Emissions per capita (CO_2 eq.)
State of Palestine	2011	0.8
Egypt	2000	3
Syria	2005	4
Jordan	2006	5
Lebanon	2000	5
Israel	2007	11

Annex A presents the data used to calculate the estimate for the State of Palestine in Table 10.

[73] PCBS (2015a) Estimated Population in the Palestinian Territory Mid-Year by Governorate,1997-2016. http://www.pcbs.gov.ps/Portals/_Rainbow/Documents/gover_e.htm

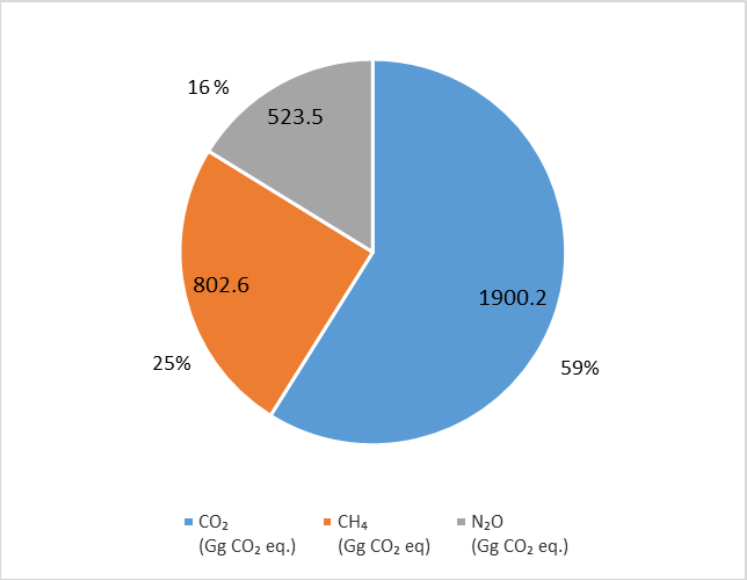
2.2.1 Direct emissions: CO_2, CH_4 and N_2O

This section presents the overall GHGI of the State of Palestine for the year 2011 and separately presents the emissions from the Illegal Israeli Settlements Regime.

All graphs and tables in this chapter are presented in GWP (IPCC AR2) weighted emissions as CO_2 equivalents as shown in Table 9.

On a GWP-weighted basis, emissions of CO_2 dominated the national total, followed by CH_4 and then N_2O; see Figure 11.

Figure 11: Total national emissions and removals (Gg of CO_2 eq.), 2011



Emissions were greatest from the energy sector, followed by waste then AFOLU sectors, as shown in Figure 12. The IPPU sector is not represented in Figure 12 because there were no direct GHG emissions from this sector. There were some indirect GHG emissions but these were estimated and have not been reported. Further information is presented in Section 2.3.2.

Figure 12: Total GHG by sector (Gg of CO_2 eq.), 2011

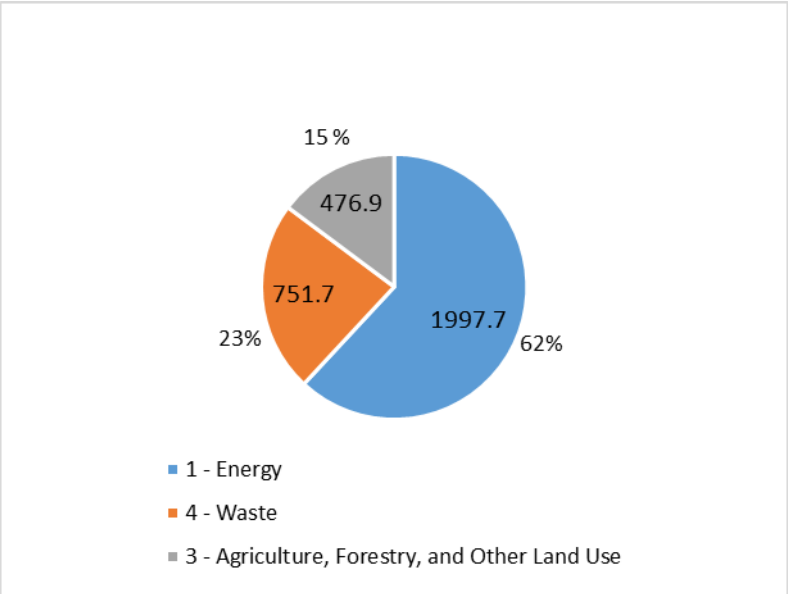


Table 11 is the standard non-Annex I (NAI) reporting table of direct and indirect GHG emissions and uses the reporting nomenclature agreed for non-Annex I Parties. In other parts of this INCR, the IPCC 2006 nomenclature is used to improve comparability with modern GHG inventories. The table provides a complete list of direct GHGs in each sector for the year 2011. Please note that these tables are in Gg and not in GWP-weighted emissions and that the notation keys signify:

- NE = Not estimated
- NO = Not occurring

Table 11: National GHGI of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol and GHG precursors[74]

GHG source and sink categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	CO Gg	NOx (Gg)	NMVOCs (Gg)	SOx (Gg)
Total national emissions and removals	1900.1917	38.2209	1.6888	NE	NE	NE	NE
1 - Energy	1930.8504	2.0447	0.0772	NE	NE	NE	NE
1A - Fuel combustion activities	1930.8504	2.0447	0.0772	NE	NE	NE	NE
1A1 - Energy Industries	391.3641	0.0393	0.0063	NE	NE	NE	NE
1A2 - Manufacturing Industries and Construction (ISIC)	51.2293	0.0018	0.0003	NE	NE	NE	NE
1A3 - Transport	930.0485	0.1728	0.0471	NE	NE	NE	NE
1A4 - Other sectors	558.2085	1.8307	0.0236	NE	NE	NE	NE
1A5 - Other	NO	NO	NO	NE	NE	NE	NE
1B - Fugitive emissions from fuels	NO, NE	NO, NE	NO,NE	NE	NE	NO	NO
1B1 - Solid fuels	NO	NO	NO	NE	NE	NO	NO
1B2 - Oil and natural gas	NE	NE	NE	NE	NE	NO	NO
2 - Industrial processes	NO	NO	NO	NE	NE	NE	NO
2A - Mineral products	NO	NO	NO	NE	NE	NE	NE
2B - Chemical industry	NO	NO	NO	NE	NE	NE	NE
2C - Metal production	NO	NO	NO	NE	NE	NE	NE
2D - Other production	NO	NO		NE	NE	NE[a]	NE
2E - Production of halocarbons and sulphur hexafluoride							
2F - Consumption of halocarbons and sulphur hexafluoride							
2G - Other (please specify)	NO	NO	NO	NE	NE	NE	NE
3 - Solvent and other product use	NE	NE	NE	NE	NE	NE	NE
4 - Agriculture		8.7754	1.0581	NE	NE	NE	NE
4A - Enteric fermentation		7.6391					
4B - Manure management		1.1363	0.0595[b]			NE	NE
4C - Rice cultivation		NO				NO	NO
4D - Agricultural soils			0.9986[c]			NE	NE
4E - Prescribed burning of savannas		NO	NO	NO	NO	NO	NO
4F - Field burning of agricultural residues		NO	NO	NE	NE	NE	NE
4G - Other (please specify)				NE	NE	NE	NE
5 - Land-use change and forestry	-35.3962	NE	NE,NO	NE	NE	NE	NE
5A - Changes in forest and other woody biomass stocks	-31.5863			NO	NO	NO	NO
5B - Forest and grassland conversion	NE	NE	NE	NO	NO	NO	NO

[74] This table represents table 1 from Decision 17/CP.8 (NCR Guidelines)

GHG source and sink categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	CO Gg	NOx (Gg)	NMVOCs (Gg)	SOx (Gg)
5C - Abandonment of managed lands	NE			NO	NO	NO	NO
5D - CO_2 emissions and removals from soil	NE		NO	NO	NO	NO	NO
5E - Other (please specify)	-3.8099[d]	NO	NO	NO	NO	NO	NO
6 - Waste	4.7375	27.4009	0.5534	NE	NE	NE	NE
6A - Solid-waste disposal on land		11.0746		NE	NE	NE	
6B - Wastewater handling		15.6437	0.5411	NE	NE	NE	
6C - Waste incineration	NO	NO	NO	NO	NO	NO	NO
6D - Other (please specify)[e]	4.7375	0.6825	0.0123	NE	NE	NE	NE
7 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
Memo items							
International bunkers[f]	NO	NO	NO	NO	NE	NE	NE
1A3a1 - International aviation	NO	NO	NO	NO	NO	NO	NO
1A3d1 - International marine (bunkers)	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass[g]	688.5626						

[a] NMVOC emissions could be produced from the food and alcoholic beverages industry.
[b] Using the IPCC 2006 reporting nomenclature, this emission is associated with category 3C6 "indirect N_2O emissions from manure management"
[c] emissions from 4D Agricultural soil come from direction N_2O emissions from managed soils
[d] the "Other" refers to "Harvested-wood products": The sink of carbon associated with harvested-wood products is automatically calculated from the quantity of wood which has been disposed into solid-waste-disposal sites (SWDS) from domestic consumption.
[e] the "Other" refers to the "open burning of waste"
[f] The State of Palestine does not have an international airport nor international bunkers.
[g] CO_2 emissions from biomass come from charcoal production, opening burning of waste, and the burning of wood and olive cake (a solid biomass fuel) for residential use.

2.2.1.1 Emissions from Illegal Israeli Settlement Regime

In 2011, there were 541,824 Israeli Settlers located in the West Bank, including East Jerusalem[75]. According to the data in Israel's second NC the emissions per capita were 10.7 tonnes of CO_2 eq. in 2007[76]. From this data, it is calculated that the emissions of the Israeli Illegal Settlement Regime are 5,798 Gg of CO_2 eq. These emissions have not been added to the State of Palestine's GHGI, as the Palestinian Government has no direct control over the activities that cause these emissions, although they occur within the Occupied Palestine Territory. Emissions from the Israeli Illegal Settlement Regime are higher than the total net GWP-weighted emissions of the State of Palestine and estimated at 180% of the country's total emissions.

2.2.2 Indirect GHGs and F-Gases

The emissions of the indirect GHGs (CO, NO_x, NMVOCs and SO_x) in Table 11 have not been estimated. It is unnecessary for the State of Palestine to estimate and report them, as they are a non-Annex I country.

The NC guidelines recommend that each country also includes a table on the national GHGI of anthropogenic emissions of HFCs, PFCs, and SF_6, as shown in Table 12. In the State of Palestine, emissions of F-gases will arise from a range of sources (such as air conditioning, and refrigeration) but no activity data are available to quantify these emissions or make accurate estimates. However, it is the view of the State of Palestine's GHGI team that the emissions from sources using F-gases will be very small both in absolute terms and as a GWP-weighted fraction of the national total emissions. This view is based on the fact that typically total F-gas emissions are approximately 1 to 3 % of national net GWP-weighted emissions.

Small emissions of F-gases will occur in the State of Palestine. A qualitative analysis suggests that emissions from stationary and mobile air conditioning and refrigeration are likely to be the most

[75] PCBS (2014) Israeli Settlements in the State of Palestine, 2013 (in Arabic). http://www.pcbs.gov.ps/Downloads/book2073.pdf
[76] Israel Ministry of Environmental Protection (2010) Israel's Second NCR. http://unfccc.int/resource/docs/natc/isrnc2.pdf

important sources, and HFCs are the most likely gases to be emitted. Some emissions of PFCs and SF_6 may also occur from the use of air conditioning and specialist electrical switchgear equipment.

Work continues to collect activity data that could be used to generate F-gas and non-direct GHGIs in the future.

Table 12: National GHGI of anthropogenic emissions of HFCs, PFCs and SF_6[77]

GHG source and sink categories	HFCs (Gg)			PFCs (Gg)			SF_6 (Gg)
	HFC-23	HFC-134	Other (to be added)	CF_4	C_2F_6	Other (to be added)	
Total national emissions and removals	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
1. Energy							
A. Fuel combustion (sectoral approach)							
1. Energy industries							
2. Manufacturing industries and construction							
3. Transport							
4. Other sectors							
5. Other (please specify)							
B. Fugitive emissions from fuels							
1. Solid fuels							
2. Oil and natural gas							
2. Industrial processes	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
A. Mineral products							
B. Chemical industry							
C. Metal production	NO	NO	NO	NO	NO	NO	NO
D. Other production							
E. Production of halocarbons and sulphur hexafluoride	NO	NO	NO	NO	NO	NO	NO
F. Consumption of halocarbons and sulphur hexafluoride	NE	NE	NE	NE	NE	NE	NE
G. Other (please specify)							
3. Solvent and other product use							
4. Agriculture							
A. Enteric fermentation							
B. Manure management							
C. Rice cultivation							
D. Agricultural soils							
E. Prescribed burning of savannahs							
F. Field burning of agricultural residues							
G. Other (please specify)							
5. Land-use change and forestry							
A. Changes in forest and other woody biomass stocks							
B. Forest and grassland conversion							
C. Abandonment of managed lands							
D. CO_2 emissions and removals from soil							
E. Other (please specify)							
6. Waste							
A. Solid-waste disposal on land							
B. Waste-water handling							
C. Waste incineration							
D. Other (please specify)							

[77] This table represents Table 2 from Decision 17/CP.8 (NCR Guidelines)

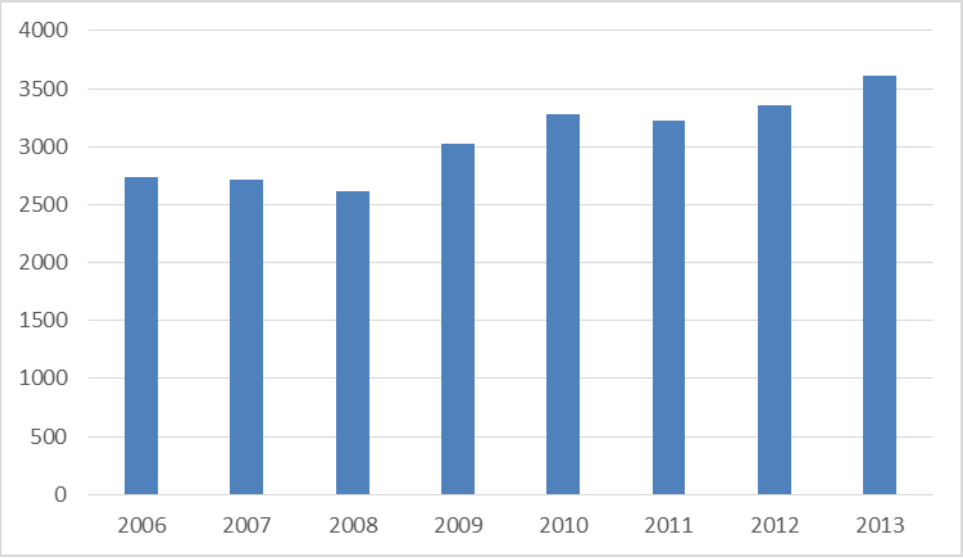
GHG source and sink categories	HFCs (Gg)			PFCs (Gg)			SF_6 (Gg)
	HFC-23	HFC-134	Other (to be added)	CF_4	C_2F_6	Other (to be added)	
7. Other (please specify)	NO	NO	NO	NO	NO	NO	NO
Memo items							
International bunkers							
Aviation							
Marine							
CO_2 emissions from biomass							

2.2.3 Overall GHG emissions time-series, 2006-2013

Figure 13 shows the overall trend in emissions from 2006-2013 in Palestine. Emissions steadily increased over time but there was no direct relationship between time and emissions, mainly because the majority of emissions came from fuel combustion in the energy sector and the consumption differed from year-to-year. Many variables controlled fuel consumption, such as the variability in the seasonal temperatures, the situation in the Gaza Strip, the unmeasured quantities of fuel used, and other statistical differences between fuel supply and demand. The energy and waste sectors were the main drivers of the increase, as the emissions from the AFOLU sector decreased over time. The use of fuel in the energy sector was responsible for driving the increase of CO_2 while activity in the waste sector (including waste disposal and wastewater treatment) was responsible for driving the increase of CH_4.

One explanation for the overall rise of GHG emissions in the State of Palestine is population growth, which could have driven increasing energy consumption, in general, as well as emissions from increasing transport activity, waste disposal and wastewater generation. Wastewater was responsible for the main increase in CH_4 emissions. Wastewater treatment is not yet fully regulated and the wastewater treatment works are in some cases old and poorly maintained. Waste disposal has been to some extent controlled with the introduction of new sanitary landfills, the closing of old dumps and the banning of illegal dumping.

Figure 13: Overall GHG emissions time-series (Gg of CO_2 eq.), 2006-2013



2.3 GHGI by sector

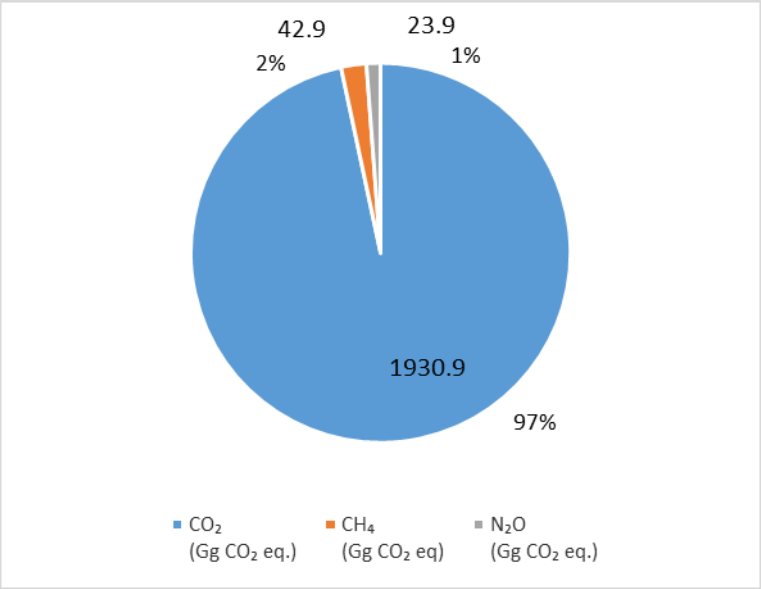
The following sections present the GHGI by sector. For each sector, the findings for 2011 are presented, then followed by the time-series from 2006-2013. The methodology, activity data, and emissions factors are presented in Table 13. All emissions presented in the graphs and tables in this chapter are presented as GWP (IPCC AR2) weighted emissions.

2.3.1 Energy

2.3.1.1 Overall energy sector

The energy sector emitted 1997.7 Gg of CO_2 eq. and CO_2 dominated the GHG emissions in the State of Palestine, with relatively very small emissions of CH_4 and N_2O. All the emissions arose from the combustion of fuel. Figure 14 summarises the emissions.

Figure 14: Energy emissions (Gg of CO_2 eq.), 2011



2.3.1.2 Energy sub-sectors

Within the energy sector, sub-sectors that contributed to GHG emissions are detailed below and shown in Figure 15.

Transport: Emissions from transport were almost half of all energy sector emissions (47%). It is important to note that the estimates were only for the road transport sector. There is no domestic aviation in the State of Palestine.

The total number of licensed vehicles was 136,877[78] in 2011; 67% of the cars are located in the West Bank and 33% in the Gaza Strip[79].

The total number of registered vehicles in the State of Palestine was 165,796[80] and the split in vehicle type was:

- Private cars: 74%
- Trucks and commercial cars: 21%
- Taxis: 3%
- Buses: 1%
- Other vehicles: 1%

[78] Number interpolated from Ministry of Transport surveys
[79] The regional split is estimated to be the same as the split of licensed vehicles 2010 as provided by Ministry of Transport surveys
[80] Number interpolated from Ministry of Transport surveys

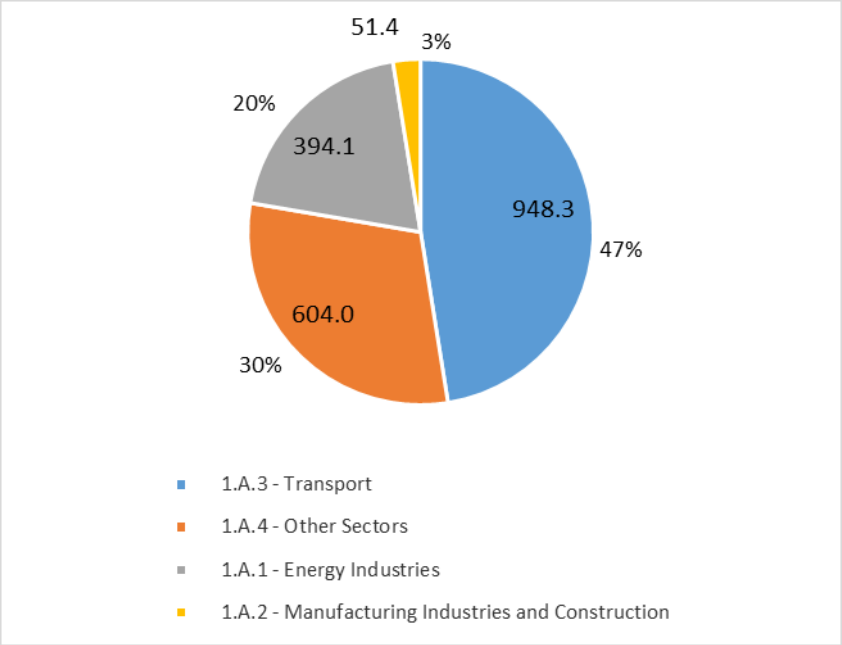
Other sectors: The "Other sectors" sub-category was the second largest contributor to GHG emissions in the energy sector. It refers to energy use in the commercial/institutional (2%) and residential (98%) sectors, as well as emissions from stationary and off-road vehicles and other machinery for agriculture/forestry. Emissions from the agriculture/forestry sector were negligible.

Energy industries: The energy industrial sector contributed 20% of emissions in the energy sector. This refers specifically to electricity generation only.

Manufacturing industries and construction: The emissions reflect the aggregated emissions from all relevant industries in the State of Palestine and contributed very little to the overall energy emissions.

Agriculture/forestry/fishing: Emissions from fishing vessels were trivial and have not, currently, been included in the GHGI.

Figure 15: Energy sub-sector emissions (Gg of CO_2 eq.), 2011



Electricity generation is not an important source of emissions in the State of Palestine. This situation is unusual in comparison to the GHG inventories of most other countries. Most of Palestine's electricity needs are supplied by Israel. Limited power generation from the Gaza Power Plant is very intermittent. The emissions from the plant are included in the State of Palestine's Energy Balance and are under the "energy industries" sub-sector.

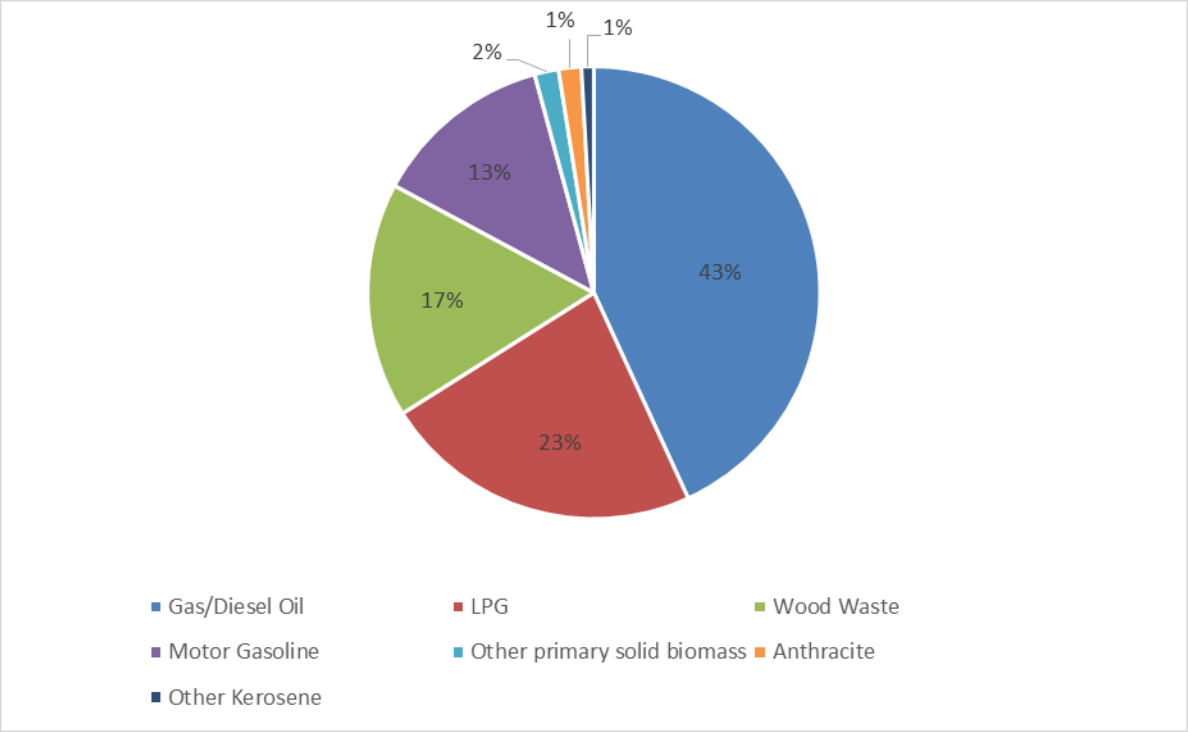
2.3.1.3 Energy sector: fuel use

In energy terms, three main fuels are used in the energy sector:

- **Gas/diesel oil:** This fuel is mostly used for electricity generation and in the transport sector.
- **Liquid petroleum gas (LPG):** LPG is mostly used in the residential sector and some in the manufacturing and industries construction.
- **Wood waste**: Wood waste is mainly used in the residential sector as well as in the process of charcoal production.

Figure 16 below highlights all the fuels used in Palestine in TJ for the year 2011.

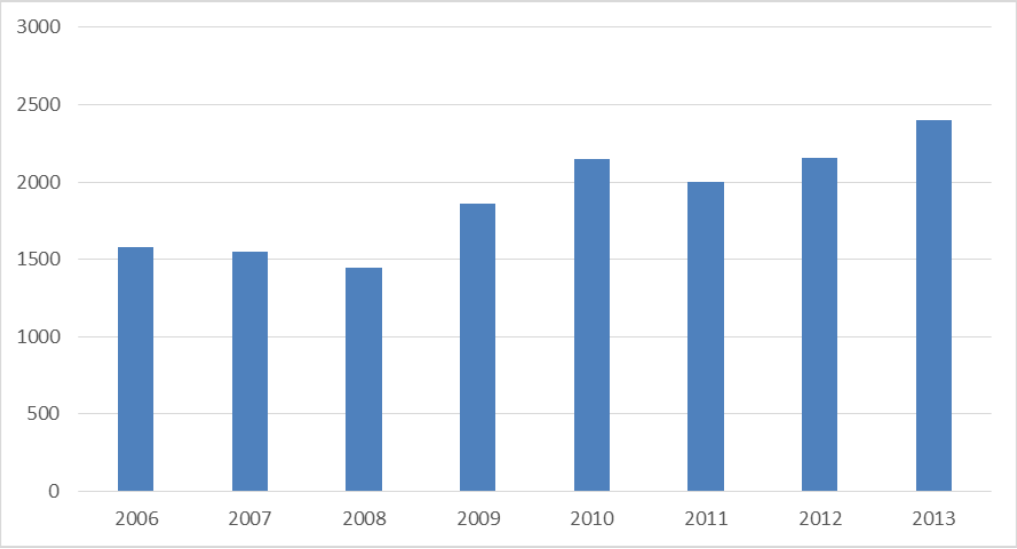
Figure 16: Energy sector fuel use (TJ), 2011



2.3.1.4 Time-series of GHG emissions for the energy sector 2006-2013

The time-series for the energy sector showed an overall increasing trend in emissions, as shown in Figure 17. The activity data for all the years 2006-2013 came from the State of Palestine's Energy Balance provided by PCBS. The main GHG driving this increase in emissions was CO_2. A potential explanation for the increasing trend was the population growth and, hence, the growing use of transport, as well as increased energy use by the residential sector.

Figure 17: Time series of GHG emissions for the energy sector (Gg of CO_2 eq.), 2006-2013



2.3.2 Industrial process and product use (IPPU)

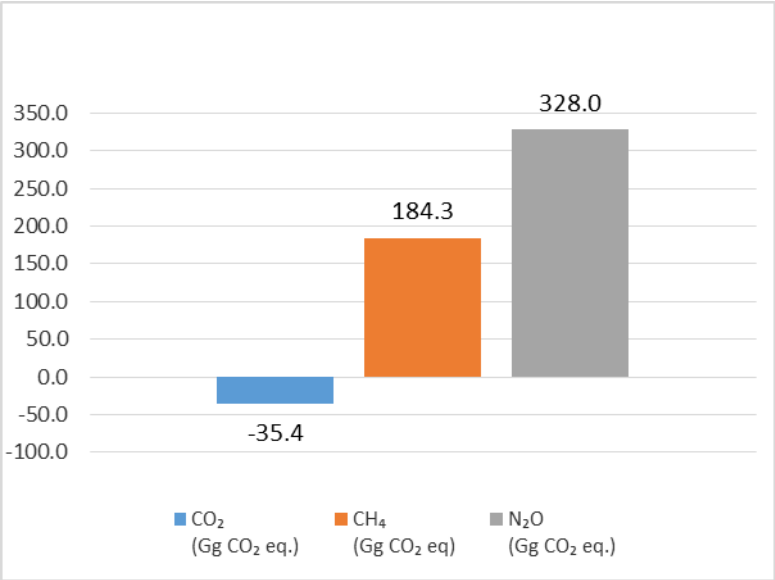
The State of Palestine has no “heavy industry”, and some, but not extensive, “light industry”. The Palestinian Government conducted an analysis of the type of industries that are present in the country, ranking them by number of employed persons, sum of number of enterprises, sum of fuel and oil use, and sum of electricity use. The aim was to identify what are the major industries in the State of Palestine, and whether they could emit GHG emissions, as process emissions. Two of the industries present in the country that could produce emissions are the “manufacture of food products” and “manufacture of basic metals.” However, none of these industries are mentioned in the IPCC 2006 guidelines as having direct GHGs emissions. Moreover, Palestine does not contain chemical, metals, or electronic industries. The GHGI, therefore, did not include any emissions from this sector. However, the State of Palestine is planning on building cement factories in 2019 that will produce 1.5 M tonnes of cement annually and 2.5 M tonnes by 2025. The Palestinian Government is creating the conditions to estimate these emissions in future GHGI submissions.

2.3.3 Agriculture, forestry and other land use (AFOLU)

2.3.3.1 Overall AFOLU sector

Net emissions in the AFOLU sector were 476.9 Gg of CO_2 eq. and was the only sector where carbon sinks occurred. There was a small net sink of 35.4 Gg of CO_2 eq. N_2O emissions dominated, followed by CH_4. Emissions of CH_4 arose from manure management and enteric fermentation. N_2O emissions arose from fertiliser application to soils, and, from indirect emissions associated with manure management. This data is presented in Figure 18 below.

Figure 18: AFOLU emissions (Gg of CO_2 eq.), 2011



2.3.3.2 AFOLU sub-sectors

Within the AFOLU sector, the sub-sectors that contributed to GHGs emissions and removals were as follows.

Land: Emissions and removals of CO_2 can occur in the AFOLU sector. To estimate the emissions and removals the calculations were based on land areas that were stratified by climate regions. The State of Palestine identified all available data on land area, use, climatic zone and vegetation type. The country is comprised of: West Bank including East Jerusalem and the Gaza Strip. The country was then segregated into five agro-ecological zones:

- Central Highlands
- Coastal plain (Gaza Strip)
- Eastern slopes
- Jordan valley

- Semi-coastal plain.

These zones were then mapped to the nearest corresponding IPCC categories: Forest land, Cropland, Grassland, Wetlands, Settlements and Other Land[81]. The current GHGI did not account for land-use changes, as land-use change data was not available.

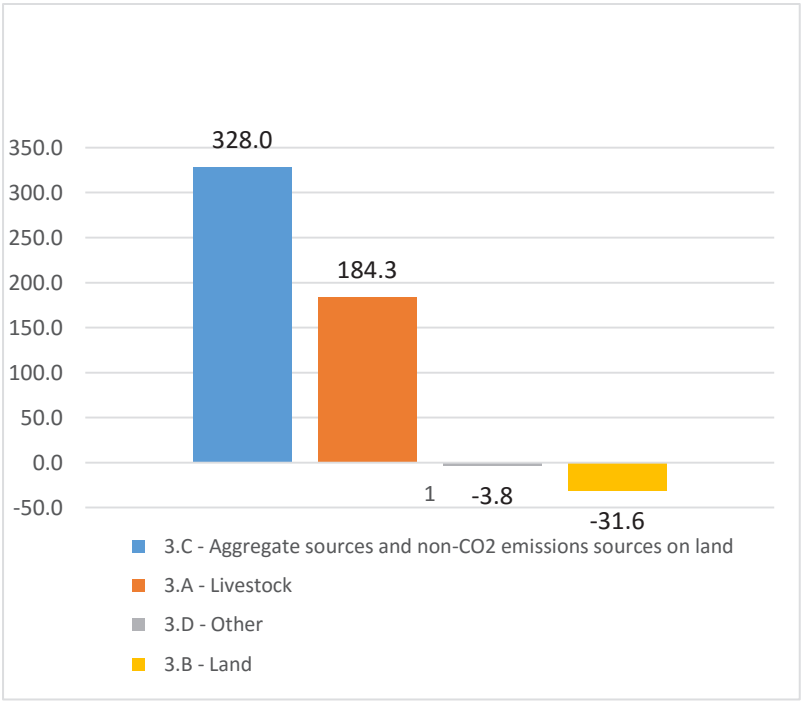
Livestock: Livestock in the State of Palestine includes dairy cows, sheep, goats, camels and poultry. Sheep and poultry, however, are the two most dominant types of animals in the country. In 2011, the State of Palestine had 732,399 sheep and 36,548,000 broilers, 1,627,000 layers, 379,257 turkeys and 504,820 broilers mothers. These along with the other livestock were responsible for producing a significant amount of CH_4. This was mainly due to enteric fermentation and manure management; there were also emissions of N_2O from manual management. There are two kinds of manure management practices in the country. The first, where manure is allowed to lie where it is deposited and is not managed; known as "pasture/range/paddock". The second, where manure is routinely removed and is applied to cropland or pasture within 24 hours; known as "daily spread". The type of manure management system greatly affects the amount of CH_4 and N_2O emitted.

Aggregate sources and non-CO2 emissions sources on land: This sub-sector only produces N_2O due to the use of ammonium sulfate, as a fertilizer. In the State of Palestine, 30,552,762 kg of fertilizer was used in 2011.

Other: The "other" sub-sector refers to "harvested-wood products" and also represented a carbon sink. The sink of carbon associated with harvested-wood products was automatically calculated from the quantity of wood, which was disposed into solid-waste-disposal sites (SWDS) from domestic consumption.

Figure 19 below higlights the emissions and removals from the AFOLU sub-sectors.

Figure 19: AFOLU sub-sector emissions (Gg of CO_2 eq.), 2011



2.3.3.3 Time-series of GHG emissions for the AFOLU sector 2006-2013

This section shows the time-series of emissions and removals for the AFOLU sector between 2006 and 2013. The AFOLU sector contained both emissions and removals. The emissions of N_2O and CH_4 were greater than the carbon sinks, which resulted in overall positive net emissions. However, net emissions

[81] See Annex B: Supplementary information about the AFOLU sector for more details.

in the AFOLU sector declined over time. This was because N_2O and CH_4 emissions overall decreased over time coupled with carbon sinks being more or less the same over the period.

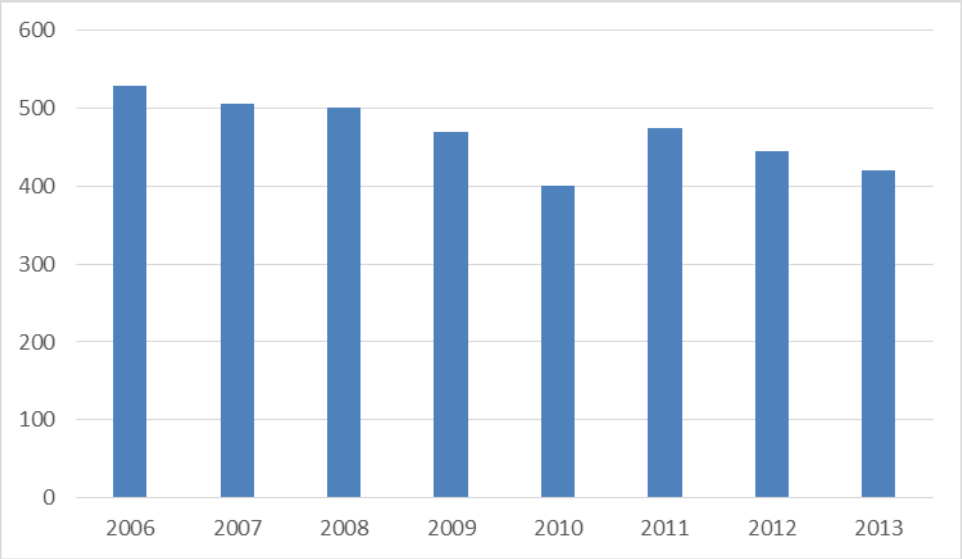
The decrease in N_2O could potentially be explained by less fertilizer being used on the land, as a result of Israel's restrictions on the importation of some fertilizers, and the decrease in CH_4 could be explained by improved manure management practices. The consistency in carbon sinks was explained by assuming no land-use change over the years.

Country-specific activity data for livestock in the State of Palestine (cows, goats, sheeps, camels and poultry) was used for each year. The data was provided by the Ministry of Agriculture. Livestock were responsible for methane emissions through enteric fermentation and manure management.

Country-specific data was also used for the use of fertilizers in the State of Palestine every year. The specific fertilizer used is ammonium sulfate, which was responsible for the release of N_2O. This data was also provided by the Ministry of Agriculture.

Figure 20 highlights the trends in the AFOLU sector for 2006-2013.

Figure 20: Time-series of GHG emissions for the AFOLU sector (Gg of CO_2 eq.), 2006-2013

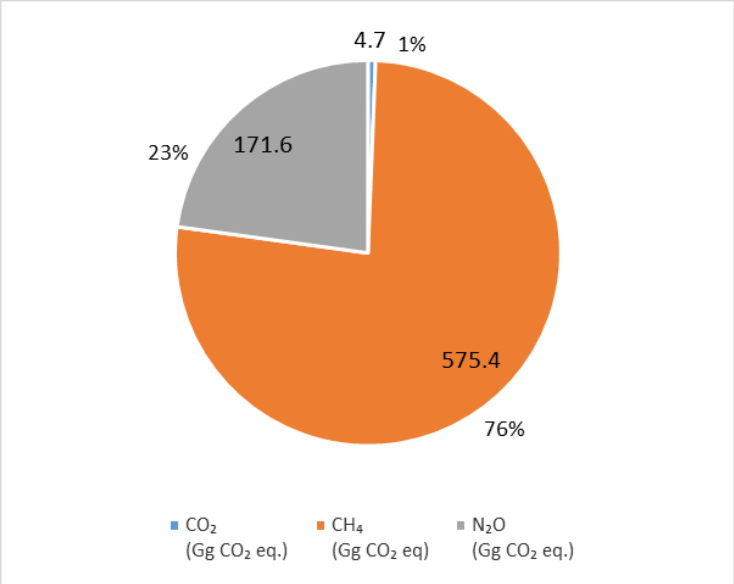


2.3.4 Waste

2.3.4.1 Overall waste sector

In 2011, emissions in the waste sector were 751.7 Gg of CO_2 eq. Emissions of CH_4 dominated, followed by N_2O. Emissions of CH_4 arose from waste decomposition and wastewater treatment, whereas N_2O emissions arose during biological nitrogen removal in wastewater treatment plants. A very small amount of CO_2 was also emitted, which arose from the burning of waste. Figure 21 below presents the results.

Figure 21: Waste emissions (Gg of CO_2 eq.), 2011



2.3.4.2 Waste sub-sectors

Within the waste sector, the categories that contributed to GHG emissions were as follows.

Solid-waste disposal

Municipal solid waste: Solid-waste disposal only produces methane emissions. In the past, the State of Palestine used waste dumpsites, as their primary method of waste disposal in addition to local burning of waste. However, the State of Palestine has made great efforts to close illegal dumpsites and has created six legal and managed landfills. Zehrat el Finjan, Jericho and Alminyeh were opened in the West Bank in 2007, 2007 and 2014 respectively. Johr al Deek, Deir el Balah and Sofa were opened in the Gaza Strip in 1987, 1996 and 1998 respectively[82]. These are "managed semi-aerobic" sites. All other waste-disposal sites are considered illegal. These shifts in waste disposal practices will undoubtedly reduce CH_4 emissions from waste disposal.

Based on information provided by the MoLG, the State of Palestine has assumed that, until 2012, 30% of the waste went into legal landfill sites, the remainder (70%) went into illegal sites and that 20% of that remainder was burnt. However, almost all burning of waste ended in 2012.

Data on waste composition was available for the landfill in the Gaza Strip, but not for other landfills. The State of Palestine has assumed that the waste composition in the Gaza Strip site applied to the waste in the other sites, and was the same for all years. The waste composition was:

- 60.6% Organic (includes food, garden waste, paper, wood and nappies)
- 33.0% Other (includes plastic, non-food yard waste, other organics, ferrous, aluminium, glass, sand/fine materials, other inorganics and ferrous)
- 6.4% Textiles.

See Annex C: Supplementary information about the solid waste sector for more information.

Industrial waste: The activity data on industrial waste has been copied over from the original PCBS inventory for the State of Palestine. PCBS had used the assumption that the estimated amount of industrial waste according to recent studies was known to be around 45% of the municipal solid waste. Based on that assumption, PCBS derived the volume of industrial waste arising. Moreover, they assumed that 69% of the waste went to Solid Waste Disposal Sites (SWDS).

Biological treatment of solid waste: This does not occur in the State of Palestine

[82] EMCC & UNDP. The Vision of Gaza after 20 Years. Available in Arabic only. PowerPoint Presentation.

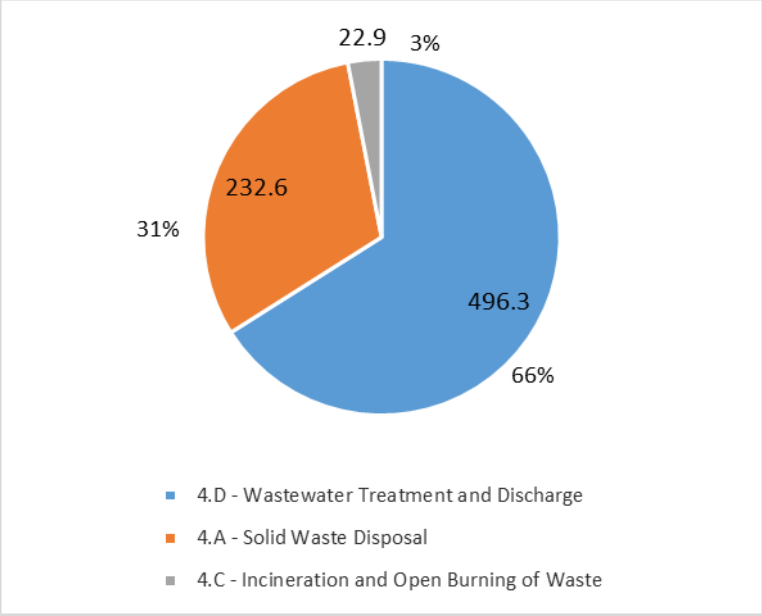
Incineration and open burning of waste: Incineration of medical waste is very limited and only gives rise to a small amounts of emissions, while incineration of municipal solid waste does not occur in the State of Palestine. However, open burning of waste does occur and contributes to CO_2, CH_4, and N_2O emissions. In 2011, it is estimated that 105 Gg/year of municial solid waste was burnt. The open burning of waste, although still occuring, has decreased substantially since 2012. With illegal dumping sites closing down and waste being shifted to legal landfills, waste burning has become a less common method of waste disposal.

Domestic wastewater treatment and discharge: The State of Palestine uses the following wastewater treatment systems: centralized aerobic treatment plant, anaerobic shallow lagoon, septic systems and latrines. Wastewater treatment and discharge arises from both domestic and industrial sites and produces CH_4 and N_2O. Emissions of N_2O are released during biological-nitrogen removal in wastewater treatment plants. The per capita protein consumption assumed in the State of Palestine was 59 g/person/year. These data were provided by the FAO for 2005-2007 and, as it is the most recent data available, was assumed to be unchanged for 2006-2013. In 2011, emissions from domestic wastewater treatment and discharge were 15 Gg of CH_4 and 0.5 Gg of N_2O.

Industrial wastewater treatment and discharge: Emissions from industrial wastewater discharge from olive oil mills were also included. The Chemical Oxygen Demand (COD factor) used was 65.7 kg/m^3. These data were country-specific and the COD factor was much higher than the IPCC default value. The value has been checked, and the current view is that it is representative. In 2011, emissions from industrial wastewater treatment and discharge were 0.6 Gg of CH_4.

Figure 22 below represents the GHG emissions contributed by each waste sub-sector.

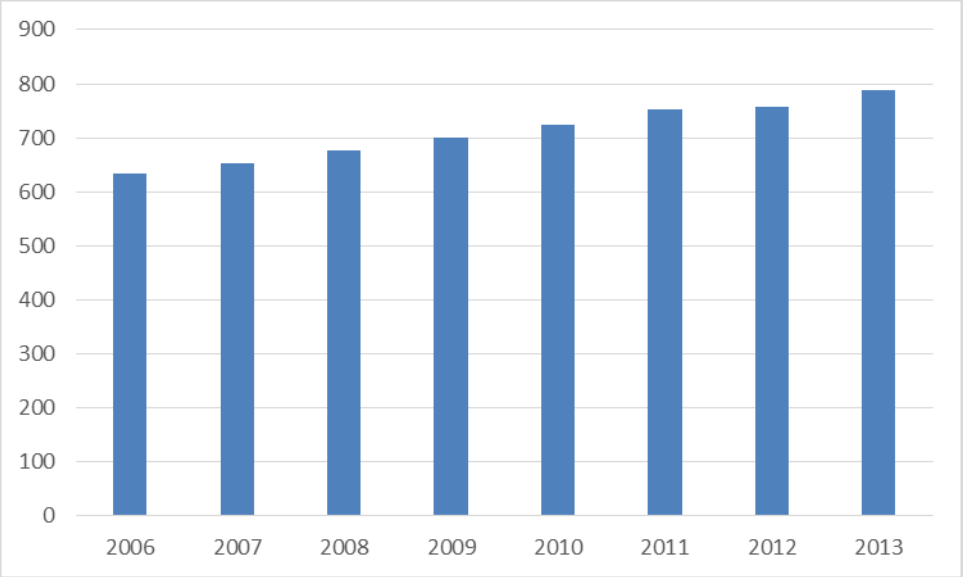
Figure 22: Waste sub-sector emissions (Gg of CO_2 eq.), 2011



2.3.4.3 Time-series of GHG emissions for the waste sector 2006-2013

The waste sector produces a significant amount of CH_4 emissions, some N_2O and very little CO_2. Figure 23 below shows the time-series for the waste sector.

Figure 23: Time-series of GHG emissions for the waste sector (Gg of CO_2 eq.), 2006-2013

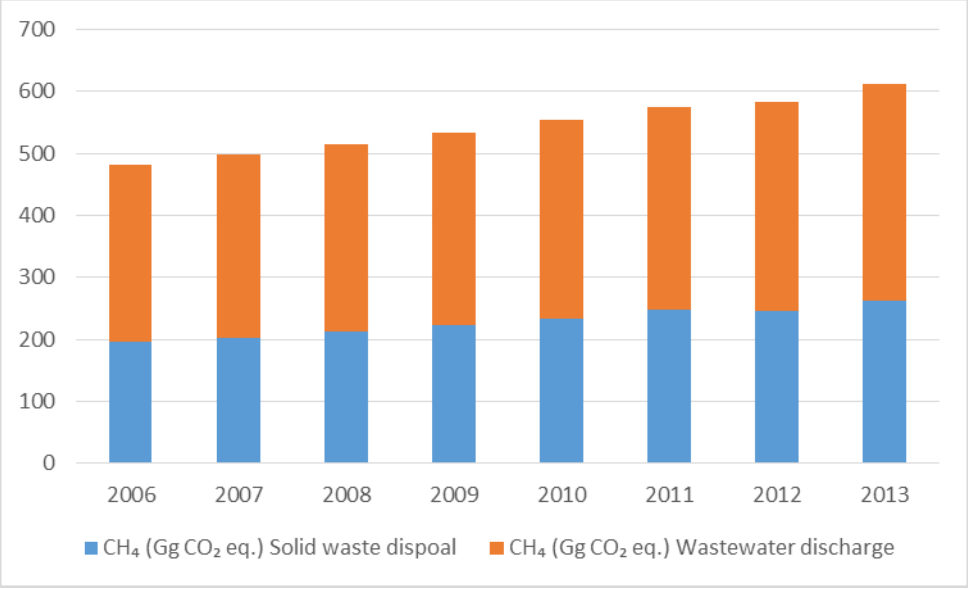


The emissions in this sector were calculated from both waste disposal and wastewater discharge (industrial and domestic). There was an increasing trend in emissions from this sector because of a population growth; waste disposal and wastewater discharge are also increased. However, the linear increase can be explained by having used population data that steadily increased over time for wastewater calculations.

2.3.4.4 CH_4 emissions from waste sector

The graph below shows the calculations that have been done separately for the CH_4 emissions from waste-disposal sites and from wastewater discharge (industrial and domestic).

Figure 24: CH_4 emissions from waste sector (Gg CO_2 eq.), 2006-2013



Methane emissions from solid-waste disposal

Palestine collected waste disposal data starting from 1980. These data allowed an estimation of how much methane has been being produced from solid-waste disposal. The activity data needed to estimate emissions from waste disposal was collected in two ways:

- 1980 – 2006: For the years from 1980 to 2006, the amount of waste generated was calculated by using UN population data multiplied by a default IPCC municipal solid waste generation

default factor. The default factor chosen was for South-Central Asia at 0.21 (tonnes/capita/year) and came from the IPPC 2006 guidelines. This factor was the most "reasonable" when compared with the data calculated for the State of Palestine for 2006-2013.

- 2006 – 2013: For the years 2006-2013, activity data on national waste generation and waste composition was collected and processed. This was done by identifying all the legal and illegal waste sites in the State of Palestine. Where data was missing, data-gap filling techniques were used, such as interpolation, extrapolation, and surrogate or proxy data.

Methane emissions from wastewater discharge and treatment

As Figure 24 shows, wastewater emissions were calculated only from 2006-2013. Wastewater emissions were based on PCBS population data. The population data increases steadily over time, which explains the steady increase in emissions. Other factors have also been calculated and were assumed to be the same for all years due to lack of data, such as the fraction of income group and the industrial wastewater from olive oil mills.

2.4 Overview of methods, assumptions, activity data, and emission factors

Table 13 summarises the methods, assumptions, activity data and emissions factors that were used in developing the GHGI for the State of Palestine.

Table 13: Overview of methods, assumptions, AD, and EF used in the GHGI

Source or sink	Methods/Assumptions	Activity Data	Emission Factors
1 Energy			
1.A.1.a.i Electricity generation	Using IPPC Tier 1	PCBS Energy Balance 2006-2013	IPCC default values
1.A.1.c.i Manufacture of solid fuels	Using IPCC Tier 1	Palestinian Data on Charcoal Production	IPCC default values
1.A.2 Manufacturing industries and construction	Using IPCC Tier 1	PCBS Energy Balance 2006-2013	IPCC default values
1.A.3.b.i Road transportation	Using IPCC Tier 1	PCBS Energy Balance 2006-2013	IPCC default values
1.A.4.a Commercial/institutional	Using IPCC Tier 1	PCBS Energy Balance 2006-2013	IPCC default values
1.A.4.b Residential	Using IPCC Tier 1	PCBS Energy Balance 2006-2013	IPCC default values
1.A.4.c.i Stationary	Using IPCC Tier 1	PCBS Energy Balance 2006-2013	IPCC default values
1.A.4.cii Off-road vehicle and machinery	Using IPCC Tier 1	Taken from PCBS inventory	IPCC default values
Industrial processes and process emissions	NA	Not Occurring	NA
Agriculture, forestry and other land use			
3.A Livestock			
3.A.1 Enteric fermentation	Using IPCC Tier 1	Country-specific data on animal heads and typical animal mass.	Region specific (Asia Middle East) Default Value
3.A.2 Manure management	Using IPCC Tier 1	Country-specific manure management systems.	Region specific (Asia Middle East) Default Value
3. B Land	Using IPCC Tier 1 Assume no land-use change from year to year (due to no data)	Broke down into 5 agro-ecological zones. Used Ministry of Agriculture data to divide the land area into these zones and to identify the climate regions, soil types, and ecosystem types.	Region specific Default Value

Source or sink	Methods/Assumptions	Activity Data	Emission Factors
3.C.4 Direct N_2O emissions from managed soils	Using IPCC Tier 1	Country-specific data used.	IPCC default values
3.D.1 Harvested-wood products	Using IPCC Tier 1	• The sink of carbon associated with harvested-wood products is automatically calculated from the quantity of wood which has been disposed into SWDS from domestic consumption. The software uses a simple decay approach. (Referred to as 5E in Table 11)	IPCC default values
4 Waste			
4.A Solid-waste disposal	Using IPCC Tier 1	**1980-2006:** calculated waste to landfill by multiplying population by appropriate waste generated/cap. **2006-2013:** used detailed activity data on waste to landfills, used various techniques to interpolate data looking at data from legal and illegal disposal sites.	IPCC default values
4.C.2 Open burning of waste	Using IPPC Tier 1	Using assumption of MOLG that 20% of waste dumped illegally was burnt.	IPCC default values
4.D.1 Domestic wastewater treatment and discharge	Using IPCC Tier 1	Country-specific data on type of wastewater treatment, population and fraction of population income group.	MCF values from IPCC guidelines 2006
4.D.2 Industrial wastewater	Using IPCC Tier 1	Used data on industrial olive mills from Palestinian academic report. Assumed the same for all years[83].	Country-specific EF

[83] Shaheen, H. and Abdel Karim, R., (2007) Management of Olive-Mills Wastewater in Palestine, Civil Engineering Department, Faculty of Engineering, An-Najah National University, Nablus, Palestine. http://blogs.najah.edu/staff/emp_3006/article/Management-of-Olive-Mills-Wastewater-in-Palestine/file/313.pdf

2.5 Key category analysis

Key categories are defined as the sources of emissions that have a significant influence on the GHGI as a whole, in terms of the absolute level of the emissions, the trend, or both. Table 14 lists the key categories, for 2011 and the base year, derived from the IPCC Approach 1 key category analysis. This analysis was completed using the IPCC software. This key category analysis includes the LULUCF sector. These key source categories have been identified so that the resources available for GHGI preparation may be prioritized, and so that the best possible estimates are prepared for the most significant categories that will help in defining areas of mitigations for proper mitigation plans. Moreover, the State of Palestine will create conditions to estimate those emissions using the Tier 2 approaches in future GHGI submissions.

Both the level and the trend assessments have been completed, following the procedure set out in the IPCC good practice guidance (2000). This means that the categories that contribute to 95% of the emissions have been identified. The emission estimates were taken from the current GHGI.

Table 14: Key categories for Palestine's GHGI, 2011.

Code of Category	IPCC Category	GHG	Reason	Contribution of Level (%)
1.A.3.b	Road transportation	CO_2	L,T	28%
1.A.4	Other sectors - liquid fuels	CO_2	L,T	15%
1.A.1	Energy industries - liquid fuels	CO_2	L,T	12%
4.D	Wastewater treatment and discharge	CH_4	L,T	10%
3.C.4	Direct N_2O emissions from managed soils	N_2O	L,T	9%
4.A	Solid-waste disposal	CH_4	L,T	7%
4.D	Wastewater treatment and Discharge	N_2O	L	5%
3.A.1	Enteric fermentation	CH_4	L,T	5%
1.A.4	Other sectors - solid fuels	CO_2	L,T	2%
1.A.2	Manufacturing industries and construction - liquid fuels	CO_2	L,T	2%
1.A.4	Other sectors - biomass	CH_4	L,T	1%

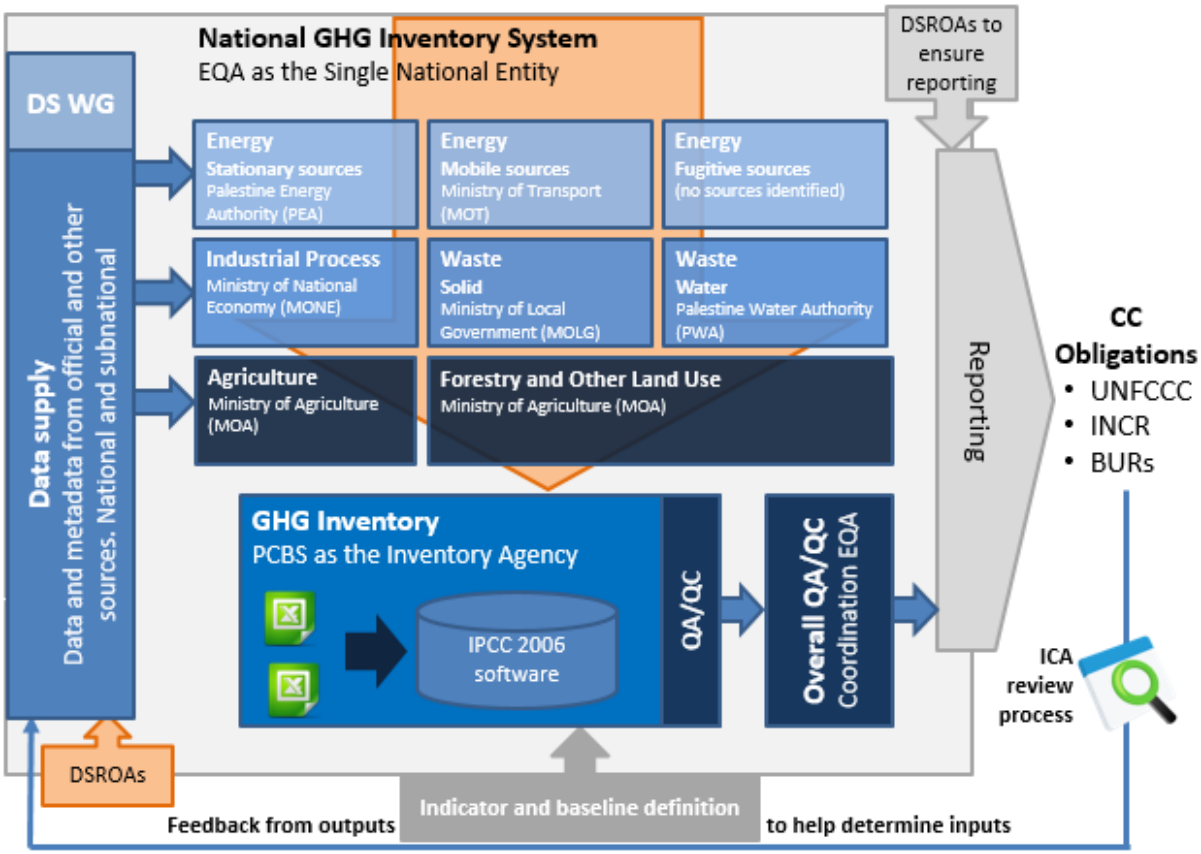
L = Level, T = Trend

As well as a quantitative uncertainty analysis, it is also good practice to complete a qualitative analysis to help prioritise GHGI improvements. The State of Palestine is completing this assessment.

2.6 Institutional arrangements

The State of Palestine has established good quality institutional arrangements for the reliable and repeatable creation and reporting of its GHGI. To meet this end, the Palestinian Government has chosen the EQA to be the single national entity responsible for developing the GHGI, and PCBS to be the inventory agency. Assigning these responsibilities in this way is not a requirement for non-Annex I countries but the Palestinian Government has done so to ensure best practice and to set-up a solid foundation for future development of the GHGI. Figure 25 outlines a national GHGI system, although there is no formal requirement for non-Annex I Parties to have a national GHGI system.

Figure 25: Institutional set-up for data collection



Notes:

DSROAs = Data Supply and Reporting Obligations

BUR = Biennial Update Report

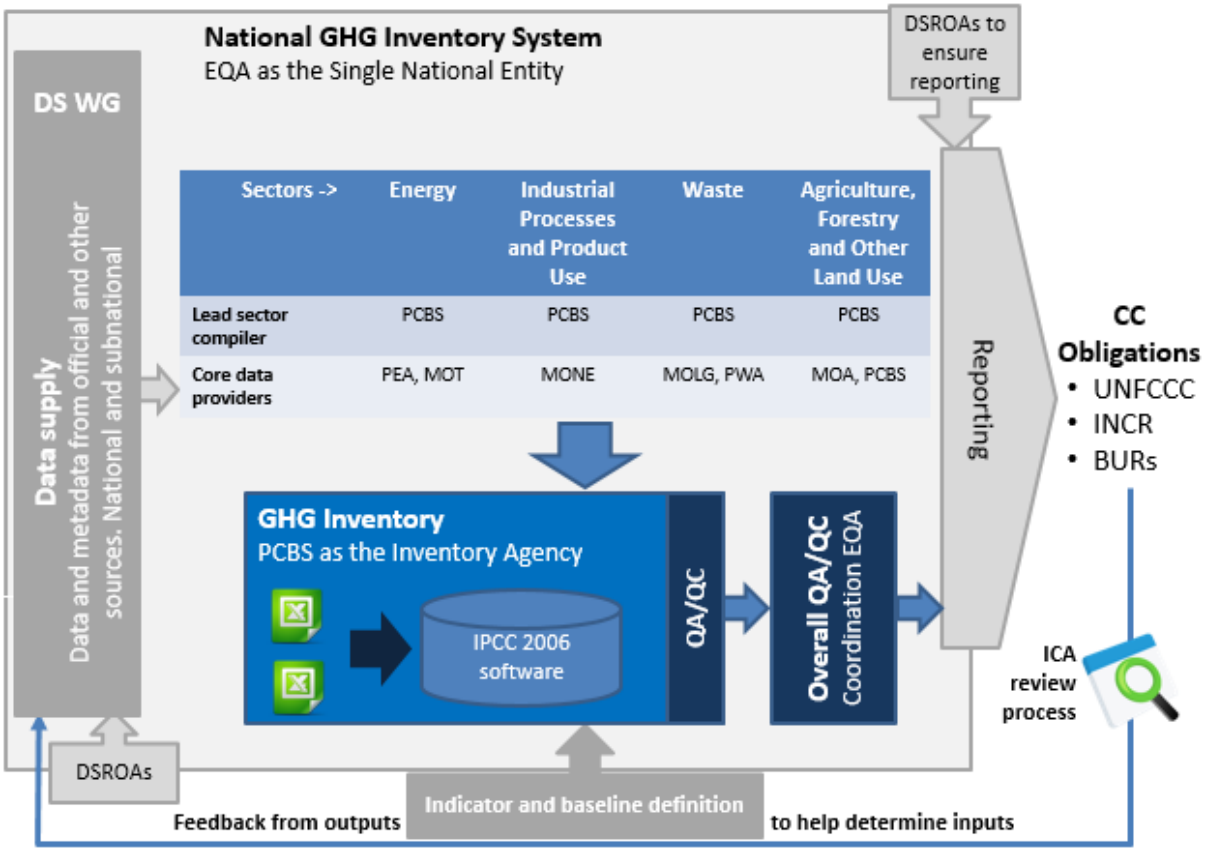
DS WG = Data Supply Working Group

ICA = International Consulting and Analysis

2.7 Approach to data collection, processing and management

In addition to developing an institutional set-up for the management, development and reporting of GHG inventories, the State of Palestine has also identified the key data collectors and compliers for each sector. This data set-up ensures that data flows are understood and managed to ensure timely delivery of good quality data. Figure 26 below highlights how the State of Palestine has allocated the data management tasks for the development of its GHGI.

Figure 26: National data collectors and compilers



Acronyms are provided under Figure 25.

In developing the GHGI, the State of Palestine followed the steps below:

- Identified what activity data was needed to create a complete and accurate GHGI
- Collected and compiled the data from the key data providers
- Divided the data into two regions: the West Bank including East Jerusalem and the Gaza Strip.
- Processed the data and used quality control (QC) methods (see Section 2.7.3)
- Identified gaps in the data compiled and requested more information from the core data providers
- Filled gaps, where necessary, using IPCC gap-filling approaches
- Reviewed updated data
- Used software
- Analysed outputs
- Presented the GHGI to stakeholders for review and made revisions as necessary

Reported.

Although the GHGI shows the emissions for the State of Palestine as a whole, it is important to note that, where possible, the activity data collected was divided between the West Bank including East Jerusalem and the Gaza Strip. This gives the Palestinian Government a more accurate view of emissions and their geographic source.

2.7.1 Data collection

In order to complete the State of Palestine's first complete GHGI, data was collected from various key institutions (PCBS, Ministry of Local Governments, Ministry of Agriculture, EQA, United Nations Development Programme/Programme of Assistance to the Palestinian People (UNDP/PAPP), and

Birzeit University) and from field surveys and administrative records. Most of the data collected was activity data (AD) but in some cases emission factors (EF) were collected. Most effort was placed on identifying the AD rather than EF primarily because, although there are adequate default EF available, AD are country-specific and needed to be sourced from within the State of Palestine.

2.7.2 Data management

In order to organize and locate the identified and collected data efficiently, a data library was created that holds the following information: data, source, summary, and region (i.e. West Bank, East Jerusalem and Gaza Strip). The data library was used to catalogue the data that was received from various institutions and sources. This approach to data organisation means that the information used to create the GHGI can be traced back to its source and data provider.

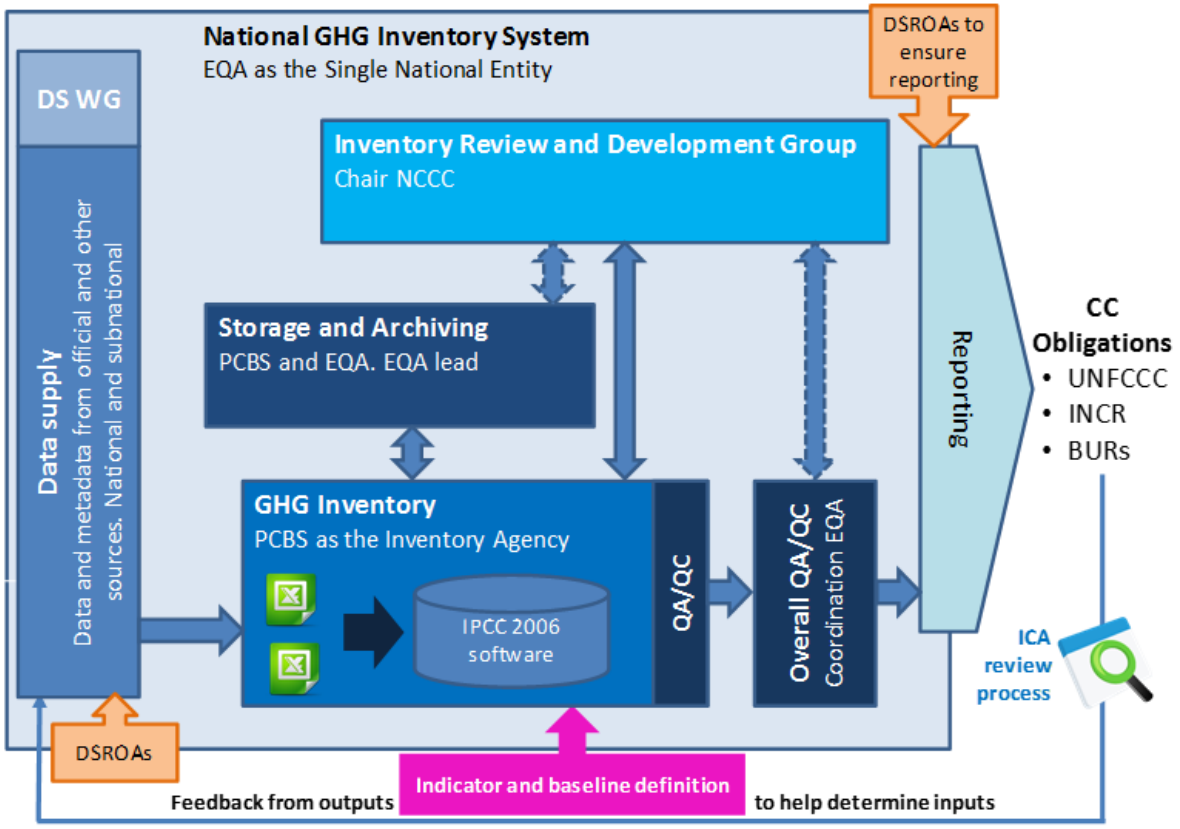
Moreover, master spreadsheets were created that combine all the information needed for a particular sector. They are the backbone of the GHGI, as they document all the assumptions, show the source of data, and the calculations are colour coded to help traceability. They also segregate the data into the three regions (i.e. West Bank, East Jerusalem and Gaza Strip). Although the GHGI is generated for the State of Palestine as a whole, these spreadsheets show how the data are spread across the three regions, which is required for mitigation assessment. They also provide more accurate and detailed information about the GHGI.

The data library and master spreadsheets contain clear guidelines on the procedures and arrangements of data collection and archiving. This information helps transparency, and documents key assumptions which is useful if there are changes in the GHGI team. Through building this GHGI, the Palestinian Government has now gained experience that it can use to continue building future inventories.

2.7.3 Quality control

Throughout the data collection and data management processes, QC measures were applied to identify and remove poor-quality data or to identify where more information about provided data was needed. These checks included, inter alia, checks on time-series consistency, mass balance checks, units, year to which the data applied, inter-comparisons of one data source with another, assessment of the magnitude of data, checks of “reasonableness”, and checks of implied emission factors against typical values. The Figure 27 below highlights the way in which quality control was institutionalized.

Figure 27: Data processing quality control deliverables



Acronyms are provided under Figure 25.

2.7.4 Reference/sectoral approach

Another important part of conducting QC for the GHGI is the calculation of a reference approach (RA) inventory. This was done using the IPCC software. The RA inventory was calculated to verify the emissions from the energy sector. According to the IPCC the "RA is a top-down approach, using a country's energy supply data to calculate the emissions of CO_2 from combustion of mainly fossil fuels". The RA was then compared to the results of the energy sectoral approach.

The comparison of the RA and sectoral approach (SA) for the energy sector in Palestine, showed a 23.8% difference. This difference was mainly due to energy statistics, such as statistical differences and uncertainty in fuel consumption and losses.

Table 15: Comparison of reference and sectoral approach

	RA	SA	% difference
Gg of CO_2	2391.9	1930.9	23.8
Energy Consumption (TJ)	33635.5	27307.7	23.1

The State of Palestine is working to reduce the difference between the RA and SA approaches.

2.7.5 GHGI review and approval

The first draft of the GHGI was completed and was presented to the various sectors involved and key data providers during a stakeholder workshop. This gave the sectoral experts the chance to challenge the assumptions made and the estimates of emissions and removals. This ensured that the sectoral experts and institutions involved were satisfied with the outcome of the GHGI while increasing its accuracy.

2.8 Uncertainties

A formal uncertainty analysis on the GHGI has not been carried out as it was decided to prioritize the creation of a complete inventory. This will be done in the BUR and Second NC Report.

In order to minimize uncertainty for this GHGI, various QC steps have been taken, as discussed in Section 2.7.3. The accuracy of the energy statics is important to the accuracy of the GHGI. The RA/SA inter-comparison will be used to help reduce the uncertainty associated with the energy statistics.

As part of the next GHGI compilation cycle, key data-providers will be asked to estimate the uncertainties associated with key sets of activity data. The methodologies set out in the IPCC 2006 guidelines for estimating uncertainties will be used. These uncertainties will then be used to inform a formal uncertainty analysis. The results of this will help refine the GHGI development programme by identifying sources that are important in terms of magnitude and trend, weighted by uncertainty.

3 GHG mitigation assessment

3.1 Introduction and methodology

The mitigation assessment is a national-level analysis of the impacts of diversified sectors and actions that affect GHG emissions. The assessment provides policy makers with an evaluation of those sectors and actions that can affect GHG emissions to establish policies and programs that could enhance the adoption of GHG mitigation measures and contribute to NAP and national development objectives.

As a member of the global community, the State of Palestine is committed to ensuring that its future emissions pathway is in line with the objective of the UNFCCC, to stabilize GHG concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. The State of Palestine's emissions per person are currently low, but the Palestinian Government is committed to playing a fair and ambitious part, respecting its circumstances, to limit emissions consistent with the objectives of the UNFCCC. This chapter sets out emissions scenarios for the State of Palestine to 2040, and a number of mitigation actions that could be appropriate for it.

3.2 Development of emissions pathways and mitigation scenarios

In common with other mitigation analyses, this chapter starts by presenting a "business as usual" (BAU) pathway for the State of Palestine. This scenario sets out a reasonable emissions pathway to 2040, consistent with the Palestinian Government's aim to end Israel's occupation, achieve independence and exercise full control over its resources. Independence will lead to increased economic activity and increased return of Palestinian refugees, as a result of the successful conclusion of negotiations and improving conditions. This BAU 'independence' pathway is based on the official plans of the Palestinian Government and was developed in close cooperation with the relevant organisations.

In order to assess the impact of the current political situation, a second pathway called the BAU 'status quo' pathway was developed. This sets out what might happen if independence was not achieved. It is important to be clear that this was only developed in order to show the negative effects if the current situation continues, and does not represent an acceptance of it.

A number of mitigation scenarios were developed building on these two pathways, showing what might happen if the State of Palestine takes additional action to reduce its GHG emissions. In common with many other countries, there are mitigation scenarios showing very high ambition, and mitigation scenarios showing what might be more realistic ambition. Six mitigation scenarios are presented here, named as shown in Table 16 below. Each mitigation scenario is defined by the political pathway and level of mitigation action.

Table 16: Mitigation scenario names

Political pathway	Mitigation scenarios		
Independence	BAU	Realistic actions	All mitigation
Status quo	BAU	Realistic actions	All mitigation

3.3 Development of mitigation actions

The State of Palestine has the potential to reduce emissions across its economy. In considering appropriate mitigation actions nationally, it was necessary to consider a number of factors. The ideal mitigation action is cost-effective, has large potential for reducing emissions, is easy to implement, and has a number of wider benefits, such as air-quality improvements and adaptation co-benefits.

Costs were assumed to be standard international costs, since most mitigation technologies are traded internationally (e.g. solar panels); sources include the International Renewable Energy Agency and the UNEP Risoe Center on Energy, Climate and Sustainable Development.

Possible future emissions from all sectors in the State of Palestine were assessed. The country is likely to develop substantially over the next 25 years, and an analysis that only focused on current emissions would, therefore, have been misleading. For example, emissions from the cement sector, and the power sector, are expected to increase substantially. The return of Palestinian refugees was taken into consideration. Ease of implementing mitigation options was another important factor, as options need to work within the political and social context of the State of Palestine. Finally, in addition to emissions reductions, some mitigation options have wider benefits, which were taken into account. For example, the option of using waste as fuel for cement production has potential wider waste-management benefits.

3.3.1 Cost-effectiveness and access to capital

Mitigation options are always assessed, at least in part, based on their lifetime cost compared to the current technology. For example, when the average lifetime cost of solar power is compared to the average cost of power from gas power stations, or the cost of electricity that households pay, it is usually identified as cheaper and, therefore, more “cost-effective”. However, many options, including solar power and energy efficiency, require significant upfront investment. The average lifetime cost may be lower, but the initial cost is high – often too high, particularly for households with limited savings or income. This is a very real problem in the State of Palestine, where at present around 50% of households in the Gaza Strip receive financial assistance and the poverty rate is around 39%. High borrowing costs can exacerbate this problem. International support can help to overcome this problem – for example by grants, soft loans and concessional loans. Innovative funding models are emerging where businesses pay the costs of installing mitigation such as solar power and then recovering the costs from households over time. This will be discussed later in the section on mitigation projects.

3.3.2 Sectoral approach

Going beyond the emissions pathways to consideration of mitigation scenarios, it was necessary to look at options for reducing emissions in individual sectors. These were assessed for cost-effectiveness, wider benefits, and their technical, technological and economic feasibility in the State of Palestine, before being combined into mitigation scenarios.

Two mitigation scenarios were identified in relation to both the BAU ‘independence’ pathway and ‘status quo’ pathway. The first was the “all mitigation” scenario, where all options considered in this report were included. The second was the “realistic actions” scenario, which focuses on a subset of the options that are particularly cost-effective, feasible and have significant wider benefits.

These options will be adopted and implemented by the Palestinian Government depending on the political situation, national circumstances and availability of an enabling environment especially: financial support, technology transfer and capacity building.

3.4 Emissions pathways for different sectors

- The starting point for each of the emissions pathways is the current emissions. These are set out in

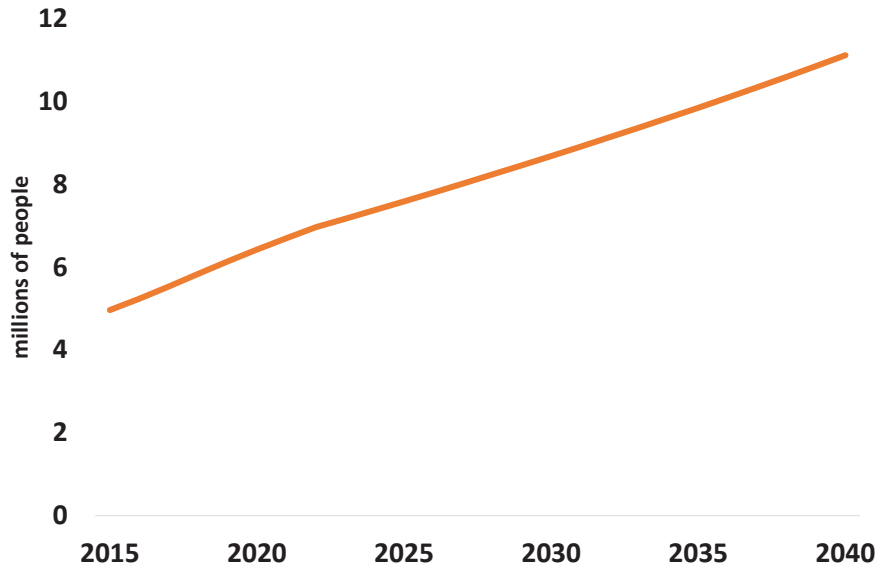
Table 11 of the GHGI chapter. This table provides the emissions by sources and removals by sinks of all GHG in each sector. Due to the annual variation in emissions, an averaging approach was used to smooth out fluctuations. Current emissions for the purposes of the projections were calculated as the average emissions over the last 5 years.

For each pathway, emissions are expected to grow in line with a key driver, which varies by sector. For example, population is the key driver of household energy demand, while for industry, the driver is

growth in GDP. Base year figures for population and GDP are assumed to follow the statistics produced by the PCBS[84].

Expected population growth in the BAU 'independence' pathway is shown in Figure 28 below. This is based on an average annual growth rate of 3.6%, although it should be noted that the rate of population growth is not uniform[85].

Figure 28: Population projection for the State of Palestine

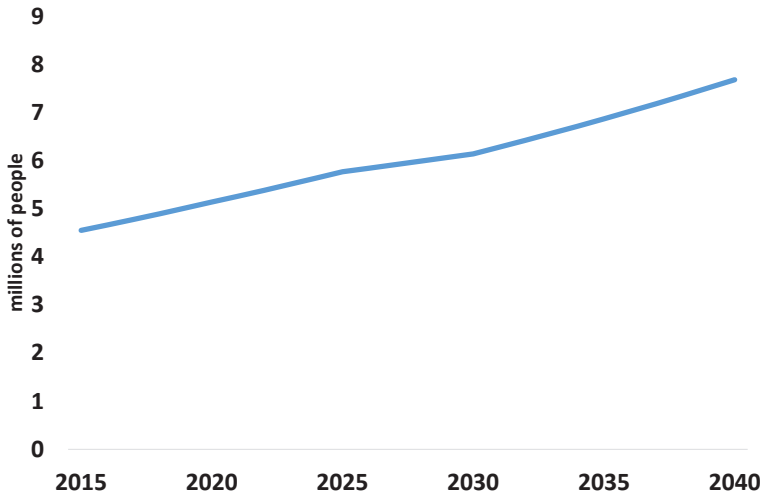


Under the BAU 'independence' pathway, growth in GDP growth is expected to be 8.4%[86] following the sectoral development plans. These plans include construction of new power stations in the West Bank, upgrades to the existing power station in the Gaza Strip and a 5% reduction in electricity consumption by 2020, as targeted in the National Energy Efficiency Action Plan (NEEAP)[87].

In the BAU 'status quo' pathway, on the other hand, population is assumed to grow more slowly at an average rate of 2.1% per year (see Figure 29) and economic growth is hindered. It will be seen later in this chapter that mitigation efforts are also significantly hindered in this situation. In the BAU 'status quo' pathway, population is assumed to grow in line with growth projections in the UN Population Divisions' World Population Prospects[88].

[84] PCBS. Estimated Population in the Palestinian Territory Mid-Year by Governorate,1997-2016 http://pcbs.gov.ps/Portals/_Rainbow/Documents/gover_e.htm
PCBS. Major National Accounts Variables by Region for the Years 1994-2013 at Current Prices. http://pcbs.gov.ps/Portals/_Rainbow/Documents/e-namcurr-1994-2013.htm
[85] Projections supplied by the Ministry of Finance and Planning (formerly MOPAD)
[86] See for example PWA (2012) National Water Strategy for Palestine. https://www.humanitarianresponse.info/system/files/documents/files/PWA%20-%20National%20Water%20Strategy.pdf
[87] Palestinian Energy Authority (2011) the Palestinian National Energy Efficiency Action Plan (NEEAP). http://www.pec.com.ps/pec/userfiles/file/English%20Book%20Final1111.pdf
[88] UN (2015) 2015 Revision of World Population Prospects. http://esa.un.org/unpd/wpp/. Note that the 2015 Revision of the World Population Prospects has been issued since the creation of these projections, which utilise data from the next latest 2012 Revision.

Figure 29: Population growth assuming current political situation continues



Economic growth is assumed to be limited in the BAU 'status quo' pathway. Based on historic experience and data from the World Bank, a figure of 5.8% growth per year was used, compared to 8.4% in the case of independence. This figure is a continuation of the historical growth trend in recent years[89].

3.4.1 BAU mitigation scenarios for households sector

Household demand is driven by the number of households (and so by population), the energy demand per household, and the types of energy that each house uses. It is assumed that the number of individuals per household remains constant.

The household energy demand is assumed to stay constant (except for the impact of the NEEAP), since the expected increased efficiency of appliances will be counter-balanced by increasing use of energy, as incomes and living standards improve. This is a phenomenon seen globally: increasing wealth leads to increasing use of energy-consuming appliances.

The types of energy used by households (the mix of electricity, LPG and other sources) are also assumed to remain constant, while the fuel used to generate the electricity is planned to change with the move to renewable energy and the exploitation of the Gaza Strip's gas fields.

Differences in household energy consumption and type between the West Bank and the Gaza Strip are considered. In the West Bank the energy use is more diverse than in the Gaza Strip. In particular, West Bank households use more diesel and gasoline[90].

3.4.2 BAU mitigation scenarios for industrial sector

Industrial demand is driven by GDP. Known plans for industrial development are included – specifically, plans for a new cement works, in the West Bank. This is expected to produce 2.5 million tonnes of cement by 2025. Cement is very energy intensive, and a major emitter of CO_2.

Under independence, the industry in the State of Palestine will grow and develop. The new industries will include manufacturing of cement and lime, some chemical production, as well as food and drink. To overcome the possible uncertainties of the industrial sector development, the overall industrial emissions are assumed to grow in line with GDP, taking account of known plans for industrial development, and industrial energy efficiency, as set out in the NEEAP.

[89] National Water Strategy for Palestine, PWA, 2012. Available at: https://www.humanitarianresponse.info/system/files/documents/files/PWA%20-%20National%20Water%20Strategy.pdf (data needed is in the appendix)
[90] PCBS (2013), Average Household Consumption of Energy from the Households that Used Energy by Region, 2013 http://www.pcbs.gov.ps/portals/_pcbs/PressRelease/Press_En_HHES072013E.PDF

3.4.3 BAU mitigation scenarios for commercial sector

Commercial energy demand is assumed to grow with GDP, except for an assumption of efficiency, as in the NEEAP to 2020.

3.4.4 BAU mitigation scenarios for transport sector

Transport demand is assumed to increase significantly: the number of cars is expected to increase, as a result of increasing GDP, and the distance travelled per person is also expected to increase.

Transport in the State of Palestine is dominated by public and private cars. Freight is moved entirely by truck, as there are no railways. There is presently no aviation, and it is assumed that any future aviation would be for international flights, given the small size of the country, hence, emissions from aviation would not be counted in the State of Palestine's GHGI. Potential growth in maritime traffic is also possible. Base-year figures for vehicles were based on a very detailed study from the Ministry of Transport.

The growth in transport emissions is an issue in many countries, with increasing population and economic development leading to a desire to travel and to an increase in private vehicle ownership. In addition, while in other sectors, such as electricity and buildings, there is significant potential for abatement, options in the transport sector are seen as more difficult.

3.4.5 BAU mitigation scenarios for agriculture and, land use and forestry sector

Agriculture is an important part of the State of Palestine's socio-economy. As shown in Table 35 of Annex B: Supplementary information about the AFOLU sector, the total area of cropland in the State of Palestine amounts to 931 km^2 (15% of the total area of the country). The densely-populated Gaza Strip (the coastal plain) is 378 km^2 and has 88km^2 of arable land.

Emissions from agriculture are around 15% of the total for the State of Palestine. It is assumed that agricultural activities, and emissions will grow in line with population.

The State of Palestine's forests occupy an area of 101.6 km, which is 1.7% of the area of the country. The forests were a net carbon sink in 2011, accounting for absorption of just under 32 $MtCO_2e$. In the BAU mitigation scenario this is assumed to continue. A mitigation option based on afforestation plans by the Ministry of Agriculture is also described.

3.4.6 BAU mitigation scenarios for waste sector

Waste is presently a major emitting sector in the State of Palestine, accounting for 23% of emissions in 2011[91]. In addition to its GHG impacts, waste, particularly unmanaged waste, is a major issue in the country, with multiple impacts. Health impacts and pollution from poorly managed or unmanaged waste disposal are a problem across the West Bank and the Gaza Strip, and waste management systems are under significant strain. In the West Bank[92], there are plans for gasification being discussed, and this is a potential mitigation option.

In future, there may be changes to the composition of household waste. However, for the purposes of the BAU mitigation scenario it has been assumed[93] that there are no changes in the volume or makeup of household waste per person over the period. Total waste volume, therefore, grows with population.

3.4.7 BAU mitigation scenarios for water and wastewater treatment sector

The future water demand is expected to reach 315 million cubic metres per year in the West Bank by 2027-32 (~300 % increase on current demand of 104 million cubic meters per year), and 145 million in the Gaza Strip (86% increase on current demand of 78 million cubic meters per year)[94]. Note that the energy requirements for the desalination and treatment of wastewater are addressed but neither the emissions arising from wastewater nor avoided emissions from improved sewerage and wastewater treatment are included. In this respect water and wastewater should be viewed as an industrial energy demand.

[91] See GHGI chapter Figure 12
[92] UNDP (2012) Feasibility Study and Detailed Design for Solid Waste Management in the Gaza Strip concluded that this was not appropriate for Gaza at present.
[93] Based on consultation with Palestinian experts in waste
[94] PWA (2012) National Water Strategy for Palestine. (final draft not available online)

In the independence scenario, the State of Palestine will have full control over water resources in the West Bank. However, in the Gaza Strip, growth in demand for water will be met by desalination. This has implications for electricity demand, since desalination uses a lot of energy. It is assumed[95] that reverse osmosis needs 3.0-5.5kWh/m^3. This is reflected in the electricity demand projections in Section 3.4.8. Currently, the Palestinian Government is raising funds (450 Million USD) for the first large-scale desalination plant in the Gaza Strip.

The energy for treatment of wastewater and sewerage may also be significant. Presently, less than half of the population has access to sewerage. Wastewater network coverage is assumed to be 60%, following the National Water Sector Strategy, and remains constant over time.

3.4.8 BAU mitigation scenarios for electricity generation sector

At present, the State of Palestine imports most of its electricity. Plans are underway to expand the electricity system in the West Bank, with the construction of 400MW[96] of new combined-cycle gas turbines by 2020 and a further 200MW by 2030. In the BAU 'independence' pathway, Palestine generates 75% of its own electricity by 2030. The existing Gaza Power Plant is presently under a transmissions constraint but this will be removed, so that the station can operate to its full capacity of 140MW. It is assumed to operate on natural gas. Although it can operate on diesel if required, it was designed to operate on natural gas and, with the exploration of the Gaza Strip's gas resources, in future, gas is the more likely fuel.

The BAU 'status quo' pathway, in which the current dependence on imports from Israel continues, is also analysed, for comparison purposes. In that pathway, by 2020, 50% of electricity is imported from outside the country including Jordan, Egypt and Israel. The other 50% will be generated nationally.

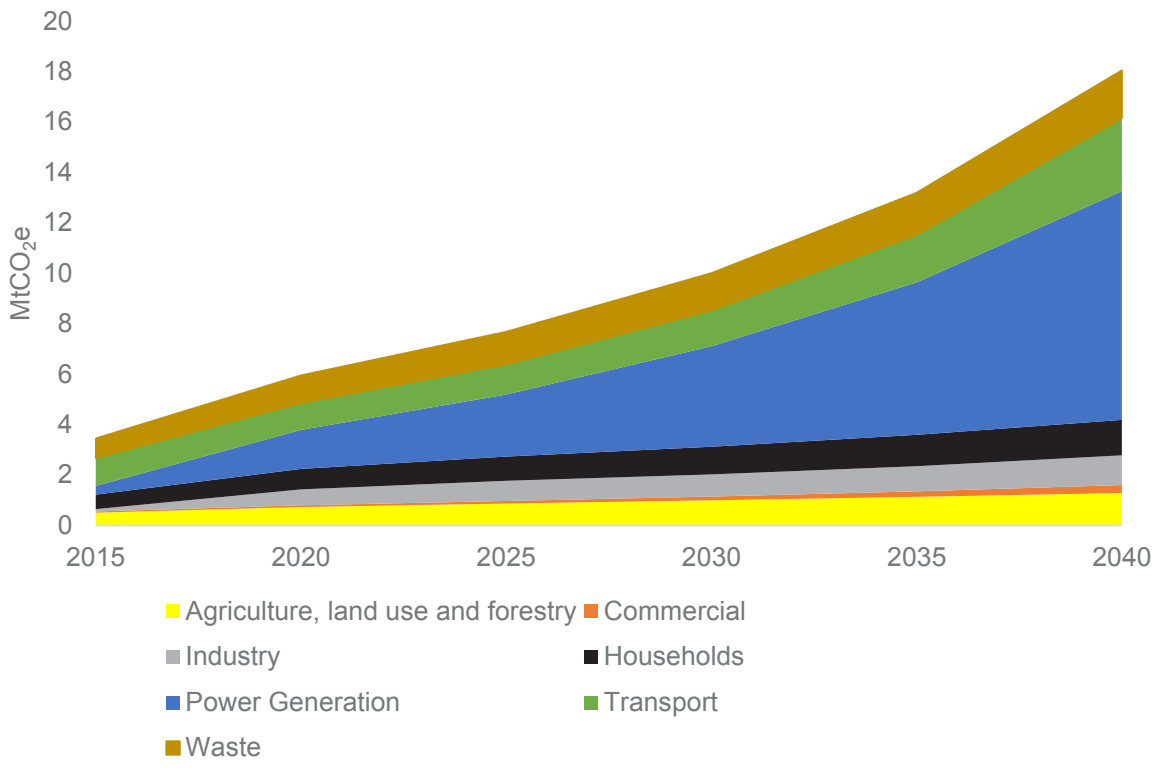
3.5 GHG emissions in BAU mitigation scenarios

Palestine's population and GDP are expected to grow substantially over the next 25 years, and without further action, this would be expected to lead to a significant increase (in the order of 500%) in emissions. This is shown in Figure 30 below.

[95] PNA and PWA (2011) The Gaza Emergency Technical Assistance Programme (GETAP) on Water Supply to the Gaza Strip - Component 1 – The Comparative Study of Options for an Additional Supply of Water for the Gaza Strip (CSO-G). https://www.humanitarianresponse.info/system/files/documents/files/PWA%20-%20CSO-G%20updated%20Final.pdf

[96] This differs slightly from the 450 MW figure for the Jenin power plant referenced earlier; 400MW was the latest estimate of the expected capacity of the Jenin power plant when the modelling was undertaken and so was the figure used in the LEAP model. The impact of changing this figure to 450MW is minor.

Figure 30: Emissions in BAU 'independence' pathway



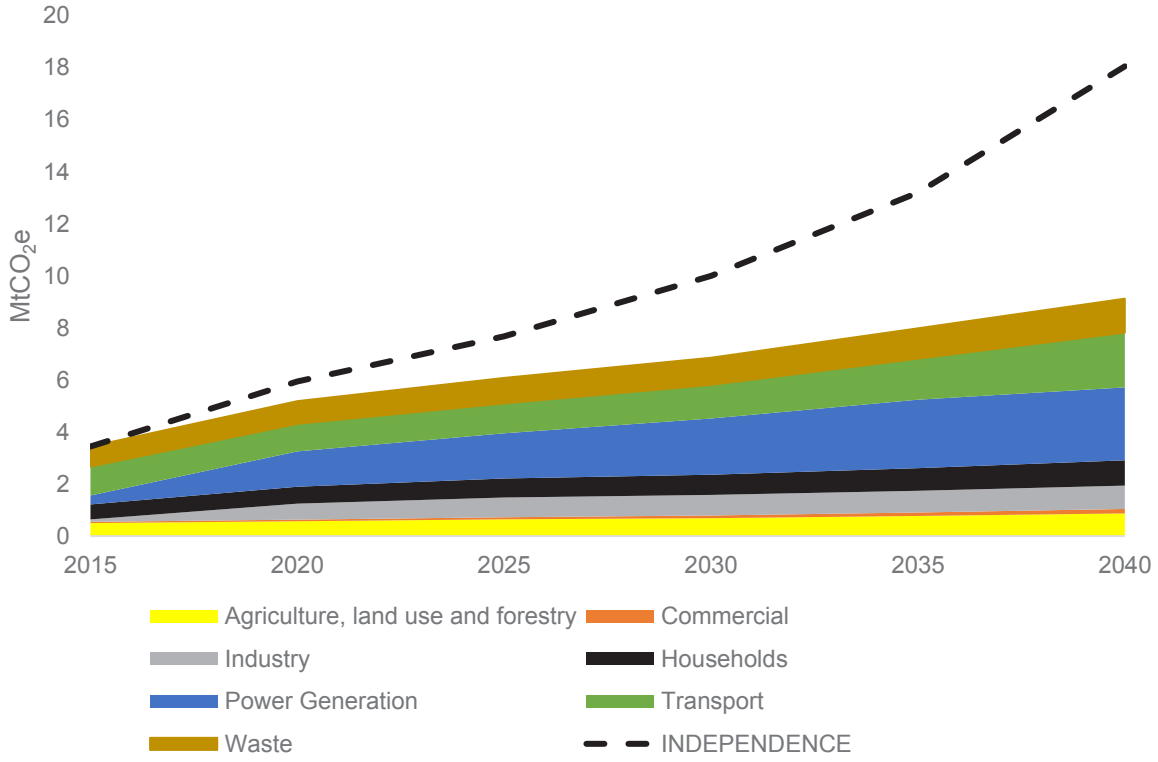
As well as increases in emissions arising from population and GDP growth, there is a significant jump in emissions from 2015 to 2020. Most of the increase is from additional power stations, but the new cement factory also has a significant impact (the grey section on the graph). Table 17 provides the emissions by sector for the BAU 'independence' pathway.

Table 17: Emissions by sector, BAU 'independence' pathway ($MtCO_2e$)

Sector	2015	2020	2025	2030	2035	2040
Agriculture, land use and forestry	0.51	0.73	0.87	1.00	1.14	1.29
Commercial	0.05	0.07	0.10	0.15	0.22	0.32
Industry	0.09	0.63	0.80	0.88	1.00	1.18
Households	0.58	0.81	0.96	1.10	1.25	1.41
Power Generation	0.34	1.55	2.46	3.99	6.05	9.07
Transport	1.11	1.07	1.20	1.42	1.88	2.90
Waste	0.77	1.09	1.29	1.48	1.68	1.89
Total	**3.45**	**5.95**	**7.68**	**10.02**	**13.22**	**18.06**

By contrast, under the BAU 'status quo' pathway, i.e. if the current occupation were to continue, emissions would be expected to grow as in Figure 31 below. A line showing total emissions under the BAU 'independence' pathway is shown for comparison purposes.

Figure 31: Emissions in BAU 'status quo' pathway



As expected, under a BAU scenario, i.e. in which the State of Palestine achieves independence and control over Occupied Palestine Territory, higher GDP and population, would produce higher emissions in all sectors. Table 18 provides the emissions by sector for the BAU 'status quo' pathway, showing an increase in total emissions by about 260%.

Table 18: Emissions by sector, BAU (status quo) scenario ($MtCO_2e$)

Sector	2015	2020	2025	2030	2035	2040
Agriculture, land use and forestry	0.51	0.58	0.65	0.70	0.78	0.88
Commercial	0.05	0.06	0.08	0.10	0.13	0.17
Industry	0.09	0.62	0.76	0.79	0.83	0.90
Households	0.58	0.65	0.73	0.78	0.87	0.97
Power Generation	0.34	1.36	1.74	2.16	2.63	2.80
Transport	1.11	1.06	1.15	1.29	1.58	2.10
Waste	0.77	0.87	0.98	1.04	1.17	1.31
Total	**3.45**	**5.20**	**6.09**	**6.86**	**7.99**	**9.13**

3.5.1 Detail of emissions by sector in BAU scenarios

3.5.1.1 Industrial sector

The majority of industrial sector emissions in the BAU scenario are from cement, particularly from the use of coal for cement production, as shown in Figure 32 and Figure 33 below.

Figure 32: Emissions by fuel, by industry

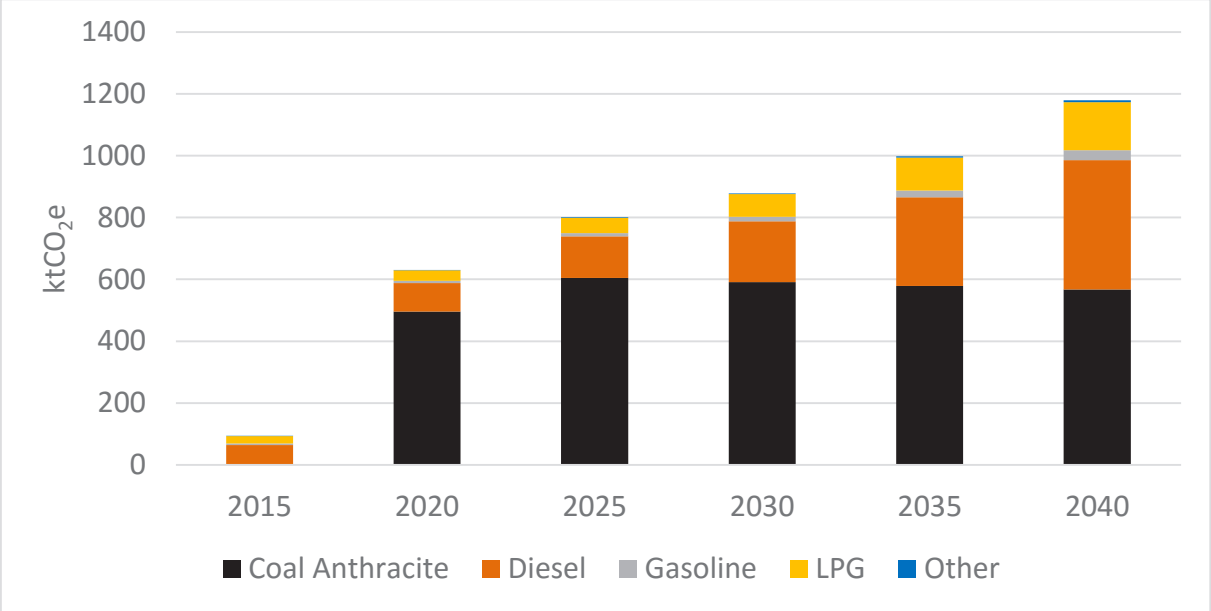
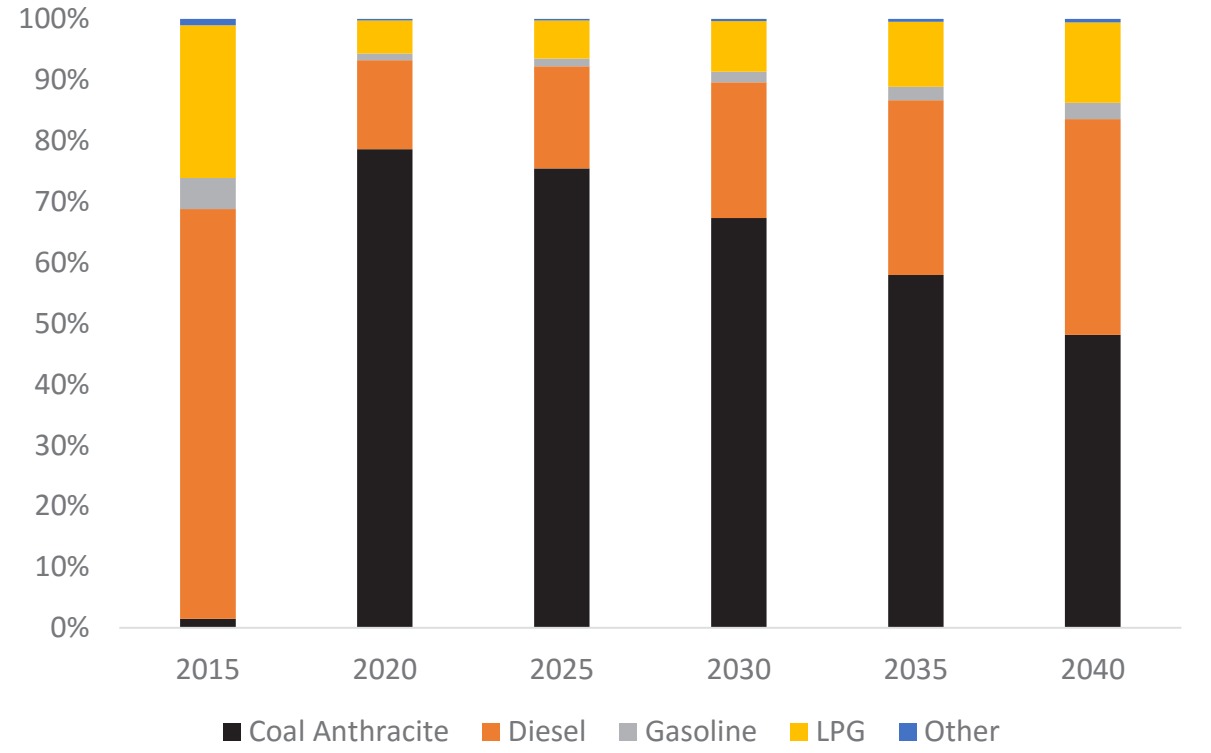


Figure 33: Emissions by fuel, in industry (as percentage of total)



3.5.1.2 Households, agriculture, waste and commercial

By assumption, demand in these sectors grow steadily. As other sectors grow more rapidly, they form a decreasing portion of energy demand and emissions by 2040.

3.5.1.3 Electricity generation

This is the sector that sees the biggest change. Essentially, evolving from a situation today where the State of Palestine has a fossil-fuel power station in the Gaza Strip, plus limited renewables, and a heavy

reliance on imported electricity from Israel, to a situation by 2040 where it has its own network of power stations that can meet the country's demand, i.e. be self-sufficient.

The change is smaller in the BAU 'status quo' pathway, where the power sector is assumed to be around half the size of that under BAU 'independence' pathway.

3.5.1.4 Transport

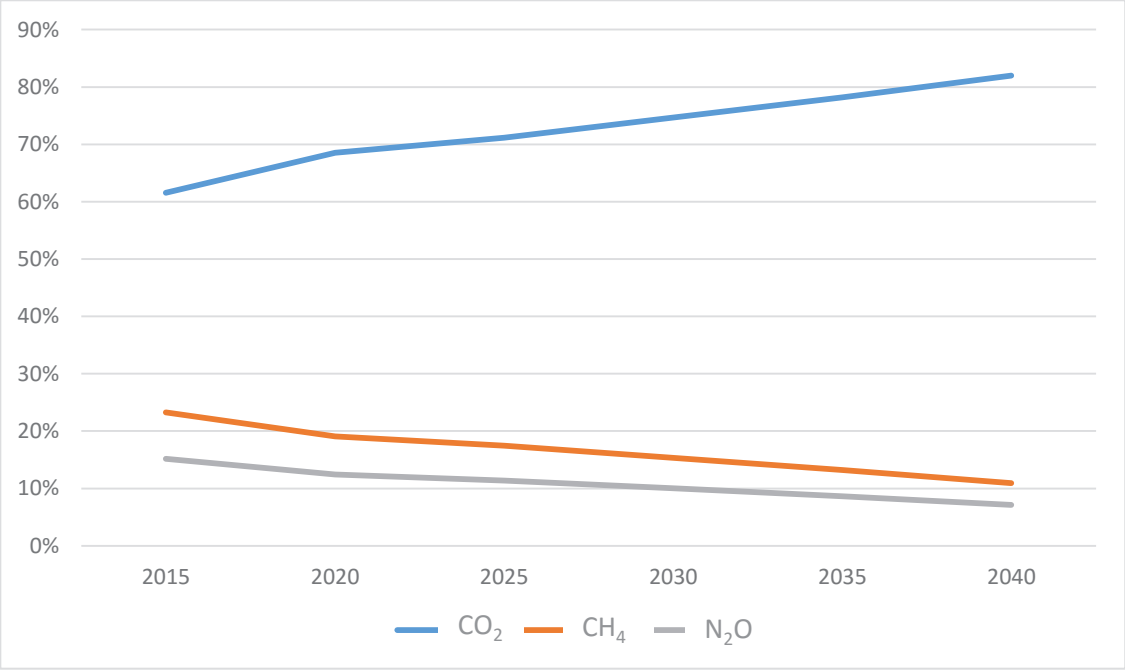
This is the sector with the largest historical emissions. Mitigation activities must, therefore, be considered in this sector. Emissions grow significantly in both pathways. This is driven by the increase expected in the number of vehicles of newly registered vehicles (which has been at an annual rate of 12,000 vehicles for the period 2010-2014) and the increasing number of old vehicles, since the number of vehicles disposed is very small. This expected increase will impact on the amount of fuel consumed and, hence, the emissions.

Under the BAU 'independence' pathway, the State of Palestine will have a much higher degree of control over the composition of the vehicle fleet in its own territory. For example, it could introduce a differential taxation regime to encourage the use of more fuel-efficient vehicles and an emissions-testing regime to ensure vehicles are maintained and, therefore, minimise their CO_2 emissions. These interventions will need support and funding.

3.5.2 Emissions by gas

As in the current GHGI, the majority of GHG emissions in the scenarios are from CO_2 and the proportion is expected to increase over time, as shown in Figure 34 below. The picture is very similar for the BAU 'status quo' pathway. The main reason for this increase is the increasing proportion of electricity generated in the State of Palestine, which leads to more combustion of natural gas, which mainly produces CO_2.

Figure 34: Proportion of total GWP by gas, in BAU 'independence' pathway



3.5.3 Comparison to other countries

Despite the increase in emissions shown in the figures above, the average emissions per person in 2040 remain low at around 1.6 tonnes (or 1.2 tonnes under the BAU 'status quo' pathway). This is an increase from current levels, but is still low by global standards. Per capita emissions of net CO_2 for selected countries are given in Table 19 below. One major factor is that the majority of the State of Palestine's electricity is currently imported from Israel, and with full independence would still be expected to import about 50% in 2020, moving to self-sufficiency in electricity by 2040.

Table 19: Per capita emissions in tonnes of CO_2[97].

Country	Emissions per capita in 2011 (tonnes of CO_2)
Qatar	44
United Arab Emirates	20
United States	17
Netherlands	10.1
Israel	9
China	6.7
Lebanon	4.7
Jordan	3.6
Yemen	1
Palestine	0.5[98]

Emissions are expected to increase nearly three times from 2011 levels by 2030 and five times by 2040 under the BAU 'independence' pathway. There is, as expected, much smaller growth emissions in the BAU 'status quo' pathway.

3.6 Mitigation options

Recognising its circumstances, and its low emissions per capita, even in the situation where no mitigation action is taken, the State of Palestine is nonetheless committed to taking action to reduce emissions in line with its national priorities, respected capabilities, potential and the principle of common but differentiated responsibilities. However, financial support, technology transfer and capacity building will be very important.

The detailed discussion of mitigation options can be found at "Annex D: Analysis of measures to reduce emissions". Details of options considered as promising are described below.

3.6.1 Proposed mitigation project in renewable energy

This is clearly a highly promising option for the State of Palestine, on which progress has already been made.

Analysis of the targets set by other countries in the Middle East and elsewhere, suggests that a level of **20%** of generated electricity would be quite in line with global practice, particularly for 2030. It is estimated that it would reduce emissions by **635,000** tonnes CO_2 eq. per year by 2040 in the BAU 'status quo' pathway, taking account of any reductions in emissions in Israel from power generation

[97] Source: World Bank. http://data.worldbank.org/indicator/EN.ATM.CO2E.PC/countries?display=default
[98] Note these are net emissions of CO_2 (not CO_2 equivalent) per capita. Emissions of CO_2 equivalent per capita in the State of Palestine is 0.8.

(due to the expected reduction in imported electricity from Israel)[99]. In the BAU 'independence' pathway, it would be possible to consider a higher target – a figure of **33%** is suggested. This would save around **2.9 million tonnes** CO_2 eq. per year by 2040.

3.6.2 Proposed mitigation projects in energy efficiency

3.6.2.1 Building energy efficiency

The State of Palestine has building standards that set limits on heat losses from residential and commercial buildings. The savings depend on building type and structure. It is estimated that if the building standards were enforced from 2016 onwards they could save **510,000** tonnes CO_2 eq. per year by 2040.

3.6.2.2 Lighting efficiency

Many of the same issues and benefits are associated with increasing the energy efficiency of lighting as with increasing the energy efficiency of buildings, although the impacts are much more limited. A 1% annual improvement in lighting demand could see savings of around **334,000** tonnes CO_2 eq. per year across all buildings.

3.6.3 Proposed mitigation projects in waste sector

3.6.3.1 Energy from waste for cement

Experience suggests[100] that waste can substitute for up to 20% of the fuel for cement production. This could save around **110,000** tonnes CO_2 eq. per year by 2040, before considering the benefits of reduced CH_4 and N_2O emissions.

3.6.3.2 Energy from waste for electricity generation

The incineration of waste can provide electricity. A 1MW unit, which consumes 50 tonnes per day of waste – a small fraction of the estimated[101] 3,000 tonnes of waste produced per day – could reduce annual emissions by around **3,000** tonnes CO_2 eq. per year and generate in the order of 60 MW of electricity.

3.6.3.3 Reduction of methane from landfill

The GHGI shows around 27,000 tonnes of CH_4 being produced in 2011 from waste, which is around 40 million m^3. This compares with the figure in the ENPI report[102] for 2020 of around 76 million m^3 of methane per year. Conservatively assuming that only around 14,000 tonnes per year is available for capture gives an annual saving of around **290,000** tonnes CO_2 eq. per year in both the BAU 'independence' and 'status quo' pathways before considering the benefits of reduced CH_4 and N_2O emissions.

3.6.4 Proposed mitigation projects in transport sector

3.6.4.1 Use of natural gas for vehicles

This involves converting goods vehicles, and public transport, to use Compressed Natural Gas (CNG). Changing vehicle fuels takes time and requires a refuelling infrastructure to be put in place. While it has previously been considered by the Ministry of Transport, it is a longer term option and more suitable for the BAU 'independence' pathway.

Taking a conservative assumption that 20% of buses and trucks could be run on CNG by 2040 gives annual savings of around **43,000** tonnes CO_2 eq. in 2040.

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[99] Because much of Palestine's electricity is imported from Israel, reductions in electricity demand in Palestine will reduce the amount of electricity generated in Palestine but also in Israel. For purposes of analysis, imports from Israel are assumed to be generated by a typical combined cycle gas turbine, with 43% efficiency

[100] Kara M. et al. (2008) The usage of Refuse Derived Fuel from urban solid waste in cement industry as an alternative fuel, 6th IASME/WSEAS International Conference on heat transfer, thermal engineering and environment. http://www.wseas.us/e-library/conferences/2008/rhodes/hte/hte26.pdf

[101] ARCADIS, IEEP, ERM, Metroeconomica, Ecologic, Ecologic Institute, Palestine Wildlife Society (2011) Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection. http://www.enpi-info.eu/library/sites/default/files/attachments/OPT-ENPI%20Benefit%20Assessment.pdf

[102] ARCADIS, IEEP, ERM, Metroeconomica, Ecologic, Ecologic Institute, Palestine Wildlife Society (2011) Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection. http://www.enpi-info.eu/library/sites/default/files/attachments/OPT-ENPI%20Benefit%20Assessment.pdf

3.6.4.2 Hybrid-electric vehicles

As noted earlier, the State of Palestine already has tax incentives in place for electric vehicles (EV) and hybrid-electric vehicles (HEV). Uptake is, however, low at present. This mitigation action looks at what might happen if the State of Palestine introduced other measures to support uptake of EV and HEV, such as promotional campaigns. It is assumed that this is more feasible under the BAU 'independence' pathway. Other neighbouring countries have already seen some uptake, or assessed HEV as having net benefits[103].

Conservatively, the analysis here assumes that the percentage of HEV in the vehicle fleet (all vehicles) grows linearly from 0% today linearly to 20% by 2035. HEV are conservatively[104] assumed to be 20% more efficient than the average new vehicle. No uptake of EV is assumed.

This leads to a reduction of **39,000** tonnes CO_2 eq. per year in 2040.

3.6.4.3 Transport modal shift

Increasing the use of public transport and reducing private car use is an option under consideration in many countries. It has wider benefits than emissions reduction, including improved air quality and reduced traffic congestion.

This option assumes that by 2030, 25% of passengers choose to travel by bus rather than purchase a car. It does not assume any construction of rail. It saves **145,000** tonnes CO_2 eq. per year by 2040.

3.6.5 Proposed mitigation project in agriculture sector

3.6.5.1 Afforestation

The Ministry of Agriculture has plans to increase forest area by 200 hectares per year until 2018, and it could be assumed that this would continue, at a lower rate, beyond that. It could save around **9,000** tonnes CO_2 eq. per year.

The next section combines these actions into mitigation scenarios.

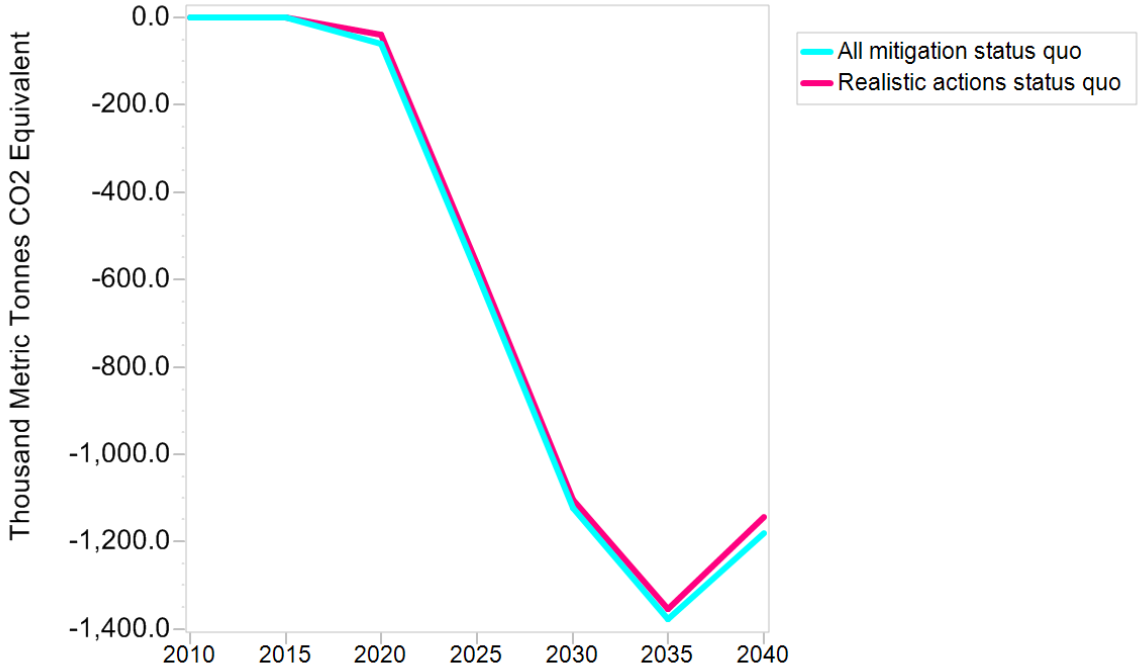
3.7 Emission reductions in mitigation scenarios

Some mitigation options save money, over their lifetime, even before counting the carbon benefits or any adaptation co-benefits. These actions could be delivered in the State of Palestine with support, including for the initial costs of the options, as well as administrative, technological and technical support. They form the core of the "realistic actions" mitigation scenario. These actions are: solar PV, building energy efficiency (if cost effective), use of waste for cement production, use of waste for electricity generation and CH_4 from landfill. Other options, while potentially still justified by a reasonable carbon price, either would be more difficult or more costly to implement. They are shown in the "all mitigation" scenario.

The impact on emissions of 'realistic actions' and 'all mitigation' scenarios in the BAU 'status quo' pathway is shown in Figure 35 below.

[103] Issam Fares Institute for Public Policy and International Affairs (2015) Harnessing Motorists' Potential Demand for Hybrid-Electric Vehicles in Lebanon: Policy Options, CO_2 Emissions Reduction and Welfare Gains.
https://www.aub.edu.lb/ifi/publications/Documents/working_papers/20150217_Harnessing_Motorists_CC.pdf
[104] The United States Environmental Protection Agency estimates that a Honda Civic 2012 travels 32 miles per gallon, whereas a Honda Civic Hybrid travels 44 miles per gallon – 37.5% further. Source: US Department of Energy Alternative Fuels Data Center www.afdc.energy.gov

Figure 35: Emissions savings (millions of tonnes CO2 eq. per year) projected for mitigation scenarios under the BAU 'status quo' pathway

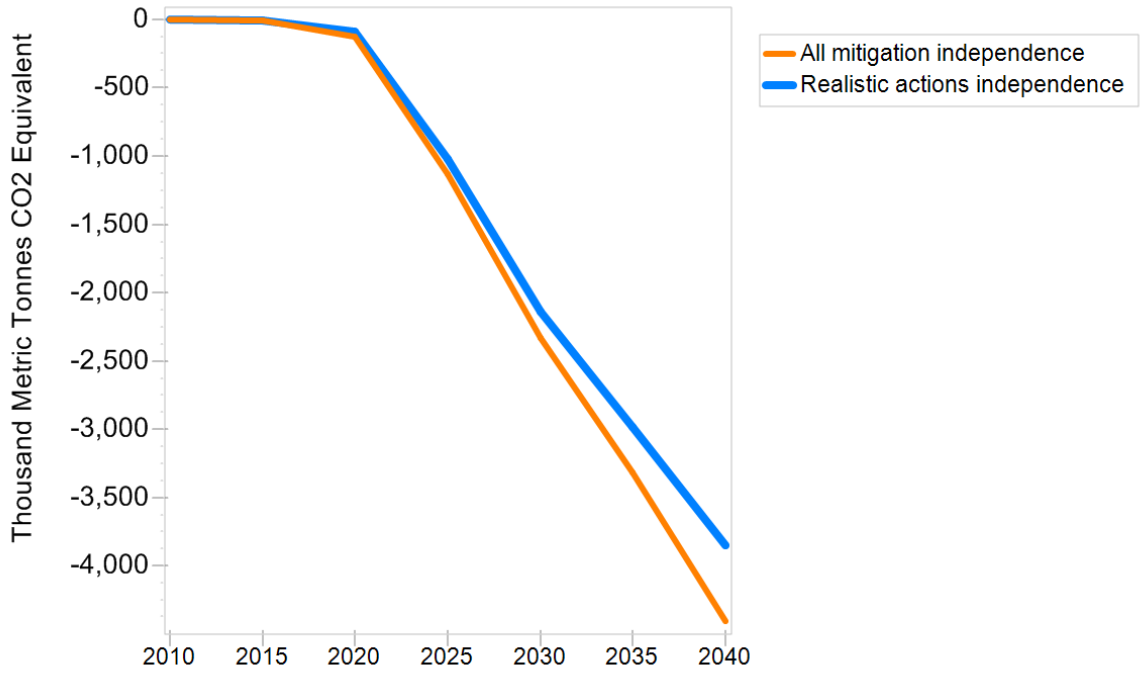


It is difficult to see the difference between the 'all actions' mitigation scenario and 'realistic actions' mitigation scenario under the BAU 'status quo' pathway in Figure 35. This is because the difference is only around 35,000 tonnes CO_2 eq. per year. The reductions are dominated by the reductions from PV, at 635,000 tonnes CO_2 eq. per year[105] and use of CH_4 from landfill at 290,000 tonnes CO_2 eq. per year. The reason for the upturn post-2035 is because solar PV is deployed aggressively but grows linearly whereas demand grows exponentially. Early on, solar PV can handle the growth in demand quite comfortably and so power plant output is very low. This makes the 'all actions' mitigation scenario look very good compared to BAU mitigation scenario in early years. Later on, demand outstrips PV capacity and so normal plants are turned back on. This means that the 'all actions' mitigation scenario generates more emissions in later years, relative to its earlier trend, although still less than the BAU mitigation scenario.

There is much more significant saving, and more difference between the mitigation scenarios under the BAU 'independence' pathway. This is shown in Figure 36 below.

[105] Includes reduced emissions from power generated in Israel and used in Palestine.

Figure 36: Emissions savings (millions of tonnes CO_2 eq. per year) projected for mitigation scenarios under the BAU 'independence' pathway



The higher savings reflect the greater potential to take mitigation action in a situation where the Palestinian Government has sovereignty, greater control over its resources and the ability to enforce standards.

Taking into account of the measures above and reductions in emissions in Israel from power generation (due to the expected reduction in imported electricity from Israel), the "realistic actions" scenario shows a reduction of around 21% as compared with the BAU mitigation scenario by 2040, while the "all mitigation" scenario shows a reduction of just under 25% by 2040. This level of reduction can be compared to the percentages already pledged by countries in their Intended Nationally Determined Contributions (INDCs) for the Paris Summit in December 2015. The Table 20 below shows pledges from countries that have presented emission reductions from a 2030 baseline.

Table 20: Pledges from countries that have presented emissions reductions from 2030 BAU[106]

Country	Emission reduction %
Ethiopia	64%
Jordan	1.5% (12.5% with support)
Lebanon	15% (30% with support)
Mexico	22% (36% with support)
Morocco	13% (32% with support)
Peru	31%
South Korea	37% (using international carbon credits)

[106] UNFCCC. Intended National Determined Contributions (INDCs). www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx

The State of Palestine also has relatively low emissions to reduce, with limited options in many sectors, for example, it has limited heavy industry and no existing coal power stations which could be converted to natural gas.

3.7.1 Costing

By looking at marginal abatement costs for each measure (see "Annex D: Analysis of measures to reduce emissions" for details) and multiplying by the potential abatement, it is possible to get an estimate of the total cost of each scenario. This is shown in Table 21 below. These figures relate to the BAU 'independence' pathway.

Table 21: Approximate costings of mitigation scenarios under the BAU 'independence' pathway[107]

Mitigation scenario	Cost in $ (2015 prices) per year in 2040
Realistic actions	-55,480,000
All mitigation	-13,215,000

Under the BAU 'status quo' pathway, the annual costs are -$20,900,000 for the 'realistic actions' scenario and -$14,280,000 for the 'all mitigation' scenario. Of course, the fact that these costs are negative means that there is a net *benefit* of the mitigation options, over their life cycle. The 'realistic actions scenario is much less costly than the "all mitigation" scenario, since it deliberately includes the cheaper options. The major options in both scenarios are solar PV and landfill gas, both of which are known to be cost-effective, and building energy efficiency (if cost effective). However, the fact that a measure has negative cost (i.e. saving) does not mean that it does not need any support. First of all, that saving is over the life of the project, not necessarily in any given year. In addition, there are many other possible barriers than overall cost. Indeed, the timing of the cost can be a barrier. Renewable energy tends to have higher capital costs and lower operating costs than other sources of energy, and this high initial cost can prevent poorer households from installing renewable energy, even if they would save money in the longer term. Given a good business and regulatory environment, energy services companies can emerge to deal with this issue, but this takes time to happen.

3.8 Selected mitigation projects

As a demonstration of its commitment to mitigation, the State of Palestine is considering the following mitigation projects:

- Solar power loans
- Solar + battery for lighting in the Gaza Strip and the West Bank
- Afforestation
- CNG taxis
- Public transportation (increase the use of buses)
- Waste-to-energy (for cement production).

These are described in more detail in the sections below.

3.8.1 Selected mitigation projects in renewable energy

3.8.1.1 Palestine solar energy services companies

As identified earlier, the State of Palestine is ideally placed to utilise solar power because of its location and solar radiation levels, as well as its existing electricity system and regulation. Indeed, solar thermal technology for the provision of hot water is already a well-established technology in the State of Palestine, where most households use it. Therefore, the problem is not lack of solar energy.

[107] The figures in Table 18 are calculated using the GACMO tool. The totals are equal to the sum of the individual measures that were costed using the GACMO tool, at levels of implementation appropriate to the respective scenarios

One of the key barriers is finance, since solar panels have a significant initial cost, which is out of reach for many, if not most, households. The private sector can overcome this barrier through Energy Service Companies (ESCOs) but demonstrating this could help to encourage them to do so. This is the basis of the proposed "Palestine solar ESCO project"[108].

The ESCO project would work as follows. A donor agency would provide a fund that offers "soft" financing terms to businesses for the purpose of installing solar power. The amount of each loan would cover installation of the panels and advice on how to secure a good agreement with the installer, including performance guarantees and an ongoing maintenance contract to ensure the panels work properly. The panels would be installed with a meter, which could be read manually or remotely (using the mobile telephone network). The business would pay per unit of electricity supplied by the panels, in the same way as they pay currently for electricity from the electricity grid. It is expected that the cost per unit would be lower, so there would be no disadvantage for the business. The decrease in cost per kWh would be roughly 0.04 USD/kWh, equivalent to a saving of 19%, based on the estimations for the levelized cost of electricity from a solar ESCO project and the retail electricity price (Table 22).This payment would go towards paying off the loan. If payment could not be made, the panels would be temporarily disconnected until payments resumed (in the same way as for electricity supplied through the electricity network). The ability to do so would need to be included in the meter, but this should be relatively simple. The loan would be written off after 15 years if not repaid.

The ESCO project is deliberately designed to be relatively commercial, including penalties for non-payment. It is intended to be a demonstration project that can encourage solar installers to come forward to offer solar panels on a similar, but fully commercial, basis. In other words, it is intended to demonstrate to the private sector that there is money to be made by installing solar panels in a way that does not require high initial payments by the recipient of the panels. However, the ESCO market is relatively immature in the State of Palestine at the moment, and to achieve provide a suitable demonstration, the ESCO market will need to be developed; engaging with the private sector, financiers, and other stakeholders. This is likely to take several years. It would also need to be carefully designed to make it compatible with local regulation and wider Islamic banking principles.

An initial assessment of the cost is as follows. It supposes that around 100 small businesses are involved. Total costs of the ESCO project would be the cost of employing one or two individuals to manage it, plus set-up costs, such as publicity and marketing. This might cost in the region of USD50,000 initially, with perhaps USD25,000 on-going cost per year. There would need to be initial costs of USD1.2m for the solar panels, but this would be recovered over the lifetime of the project. If needed, this initial cost could be spread over a number of years by only installing a fraction of the 100 installations each year

Such a project would have significant benefits in addition to financial gains. Due to the greater energy security associated with solar power, businesses could rely more on their power supply, making it easier for them to operate. There would also be a reduction in any need to upgrade electricity networks, and a reduction in losses and theft of electricity.

Table 22: Cost assumptions for Gaza solar ESCO project

Assumption	Value	Source
Businesses involved	100	Assumption
Size of panels installed for each business	5kW	Value used by Palestinian Solar Initiative (PSI)
Upfront cost	USD2,400 per kWp	IEA[109]

[108] A study of similar business models was undertaken by the IEA Renewable Energy Technology Deployment programme. Würtenberger,et al. (2012) Renewable Energy Technology Deployment, Business models for renewable energy in the built environment. http://iea-retd.org/wp-content/uploads/2012/04/RE-BIZZ-final-report.pdf

[109] International Energy Agency (2014), Technology Roadmap; solar photovoltaic energy. https://www.iea.org/media/freepublications/technologyroadmaps/solar/TechnologyRoadmapSolarPhotovoltaicEnergy_2014edition.pdf

Assumption	Value	Source
Operating, maintenance and administrative costs	4% of upfront costs/ year	Assumption. IEA estimates around 2% for operating and maintenance costs
Loan rate	6%	Assumption for "soft" loan
Electricity per unit per year	9,198 kWh	5kW at load factor of 21%
Levelized cost of electricity per kWh	0.17 USD/kWh	Calculated from the above
Retail electricity price	0.21 USD/kWh	PSI

3.8.1.2 Gaza solar and battery lighting

One constraint on solar power is often the inability to provide power during hours of darkness. However, Palestine is already installing building-scale PV with on-site battery storage. A recent analysis[110] looked at size and cost for a typical system to cover lighting needs for an apartment in the Gaza Strip. It concluded that a system with 160Wp, one battery of 100Ah capacity would be needed, and that the cost per unit of electricity would be USD0.38/kWh. This is above the cost of electricity from the grid (USD0.21) but well below the cost of a diesel generator (USD0.75/kWh). It is also more reliable than grid electricity, providing power for lighting for the entire day. Lighting demand from homes in the Gaza Strip is estimated at around 600GWh by 2020. Lack of lighting in evenings can lead to reliance on other sources (e.g. kerosene, which has air quality implications) or curtailment of evening leisure, work or study.

This suggests a possible mitigation project. Supplying 10% of households in the Gaza Strip with a solar PV+ battery system that would supply lighting demand would save around 30,000 tonnes of CO_2 per year, and would reduce grid electricity demand by 60GWh. Based on the costings above, this would lead to an annual cost of $10.2 million[111], although this would be reduced, and would even save money, if the project focused on homes with diesel generators. This cost is likely to decrease in future, as solar panels and batteries continue to reduce in cost.

Training and support could be needed for solar installers, although since the technology is already deployed to some extent in the Gaza Strip, there is already some skills base.

3.8.2 Selected mitigation projects in transport sector

3.8.2.1 CNG taxis

With the exploitation of the Gaza Strip's gas field, the use of natural gas in the State of Palestine could become more common. One mitigation measure that could make use of this is compressed natural gas (CNG) for taxis.

As a pilot, 25 existing taxis in one town could be converted to dual-fuel, at an estimated cost of around USD1,500 each[112]. The construction of necessary fuelling infrastructure could be costed at around USD375,000[113], but this could form the basis of a filling station for other CNG vehicles. A total cost estimate would, therefore, be of the order of USD410,000. Benefits would include improved air quality, and lower fuel costs for taxi drivers.

However, under the current situation, CNG for vehicles is restricted because of an agreement between the State of Palestine and Israel. If this does not change, the option of CNG taxis may not be possible. An alternative option is the use of hybrid taxis. Hybrid vehicles have a higher upfront cost but are more

[110] Abu-Zarifa, A. (2014) System Design of Photovoltaic-Solar Home Lighting for Household in Gaza strip, 3rd International Conference on Geological and Environmental Sciences. http://www.ipcbee.com/vol73/014-ICGES2014-R0019.pdf
[111] Cost per kWh of $0.38 compared to grid electricity at $0.17, times 60GWh
[112] UNEP (2015) GHG Abatement Cost Model (GACMO).
[113] Estimated cost $250,000-$500,000, "small station, time fill". Source: U.S Department of Energy (2014) Costs Associated with Compressed Natural Gas Vehicle Fuelling Infrastructure - Factors to consider in the implementation of fuelling stations and equipment. http://www.afdc.energy.gov/uploads/publication/cng_infrastructure_costs.pdf

efficient and, for high-mileage vehicles such as taxis, can be a very cost effective option (a saving of USD200/tonne of CO_2 assuming 10,000 miles per year per taxi). A leasing model, where a central body offers taxis for lease to drivers, could help to manage these costs. An international study suggests that the higher upfront cost will reduce to around 10% by 2020, which will limit the cost of the programme.

3.8.2.2 Public transportation

In order to encourage the use of public transport, it needs to be made easier to use, cheaper, and more attractive to passengers. Actions would include:

- Developing a standard public service contract following the best available international standards
- Putting in place mechanisms to detect issues with vehicles, and force operators to resolve them, possibly as a condition of the public service contract
- Simplifying fare systems and identify improved approaches to fare collection
- Exploring the option of natural gas vehicles (possibly in conjunction with project for CNG taxis discussed earlier)
- Improving information provided to passengers, such as improved maps, or better real time information about how services are running
- Improving more energy efficient and larger buses to replace smaller vehicles.

An initial estimate of costs could be up to USD2M per km, but this can be recovered through passenger fares.

3.8.3 Selected mitigation project in waste sector

3.8.3.1 Waste to energy (for cement)

A further possible mitigation project, which would have numerous co-benefits, is the use of waste for energy. There are many ways to do this but the focus here is on the use of municipal solid waste (MSW) to create refuse-derived fuel (RDF), as fuel for the cement industry.

Estimates[114] indicate that by 2020, the State of Palestine could be producing over 2 million tonnes per year of municipal waste. If even 5% of this could be captured and converted to RDF, this could yield enough fuel to supply one third of the needs of the new cement plant. This would have significant carbon benefits, as the RDF would substitute for anthracite and the waste would not go to landfill and produce CH_4. It would also increase energy security by reducing imports of coal and provide jobs.

Further use of RDF in incineration units would be possible, but the focus here is on reducing the use of coal in cement production.

In order to minimise costs, it is proposed that the RDF production facility would be sited near the cement factory. An approximate estimate for an RDF production facility supplying around 100,000 tonnes of RDF per year would be around USD 25m, based on expert judgement. However, much of the cost of this facility could be recovered through sale of the RDF to the cement factory and potentially other industrial users in future. Therefore, the builder of the facility could be expected to be willing to build it for less than the full construction cost, provided that they could keep the revenue from the sale of the RDF.

It is, therefore, proposed that a contract is tendered to build a MSW treatment facility. Bidders would be judged on technical capability but also on price. As the cement factory would be the sole initial customer, it would need to be closely involved in the project.

3.9 Summary and links to other national goals

The State of Palestine, while a relatively small contributor to climate change, has set out how it can deliver a fair and equitable contribution to the global mitigation effort with appropriate international support.

[114] ARCADIS, IEEP, ERM, Metroeconomica, Ecologic, Ecologic Institute, Palestine Wildlife Society (2011) Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection. http://www.enpi-info.eu/library/sites/default/files/attachments/OPT-ENPI%20Benefit%20Assessment.pdf (Table 5-1: Baseline total municipal waste generation)

The delivery of projects or actions like those described in this chapter will also help to achieve a number of other national development and policy objectives. These include improvements in the State's energy security, with a reduced dependence on imported electricity and increased energy reserves through development and exploitation of the Gaza Strip's gas field. Improvements in the Palestinian people's living conditions and environment, through better air quality and less unmanaged waste, are also important co-benefits.

National mitigation plans will be implemented on a voluntary basis and their implementation is linked to the provision of financial support, technology transfer and capacity building.

4 Vulnerability assessment and adaptation (V&A)

This chapter explains the methodology used to develop the State of Palestine's National Adaptation Plan (NAP) and provides:

- An assessment of historic trends in climate in relation to the State of Palestine
- Identification and prioritization of vulnerabilities
- Future climate-scenarios for the State of Palestine
- Identification and prioritization of adaptation options, including costings
- Future developments required for the State of Palestine's institutions to be able to participate in climate-modelling research
- An outline of the process for future monitoring and evaluation; and
- Next steps.

4.1 Methodology

4.1.1 Assessment of historic trends in climate

Historic trends in climate in relation to the State of Palestine have been assessed to provide a context for considering the climate sensitivity of potential vulnerabilities across the State of Palestine's various sectors in preparing the NAP and Initial National Communication Report (INCR).

The objectives of climate-trend analysis are not only to identify multi-year trends in climate parameters but also to distinguish between natural variability, on any timescale resulting from natural causes, and long-term trends resulting from the influence of human beings.

It was not intended that this historic trend analysis should be used as the basis for establishing a baseline for future climate projections that can be used to inform assessment of exposure and prioritization of adaptation actions in preparing the State of Palestine's NAP and INCR. It should also be noted that historic trends need not necessarily continue in the future under climate change.

Appendix 1 to the NAP provides:

- A discussion of uncertainties in relation to estimating trends for the various parameters considered.
- Global analyses of observed trends in relation to the State of Palestine interpreted from the charts provided in the IPCC's Fifth Assessment Report, Working Group I, (IPCC AR5), published in 2013.
- A review of climate trends assessed at a national level in documents submitted to the UNFCCC for countries in the vicinity of the State of Palestine, namely Lebanon, Jordan, Israel and Egypt.
- A summary of a representative sample of numerous papers, identified from a literature search, that consider regional climate trends in and around the State of Palestine, assessing either trends in climate parameters themselves or trends in impacts of changes in these parameters. The geographical locations of the studies vary but, given the relative uniformity of the climate across the larger region, studies undertaken in climates similar to those in the State of Palestine were reviewed. Thus, studies for Lebanon, Jordan, Syria, Israel, Saudi Arabia and Egypt have been included.

Temperature is the most straightforward of all climate parameters to submit to trend analysis. This is because temperature tends towards statistically normal distributions and uniformity over large areas, and adheres to basic laws of physics. Analyses of combined temperature parameters, such as the length of heat waves, however, suffer from the relatively few occurrences within the data record with which to determine any trends.

Trends in rainfall are more difficult to analyse than those for temperature. Rainfall is not only non-normally distributed but is also spatially variable, with trends perhaps dependent on the location of a specific rainfall gauge. In the case of the State of Palestine, rainfall is often convective (i.e. When the land warms up, it heats the air causing it to expand and rise. As the air rises it cools and condenses leading to rainfall) and is controlled to an extent by landform. Thus, geographically-close rainfall gauges

may provide very different recordings of any particular event and it is plausible that a slight change in predominant wind direction might result in a rainfall trend at particular locations in the country.

Calculated trends may critically depend on the length of the selected period of the record. This is particularly the case for rainfall for which there may be inherent cycles of some form that may appear as trends over specific intervals of analysis. Even where cyclical behaviour is not apparent, trends in rainfall may appear for a number of years for reasons that may be difficult to ascertain and may then reverse, equally without obvious cause. The issue of possible cycles in rainfall in the Levant is certainly a complicating factor that might affect not only the identification of trends in the rainfall itself, but also trends in combined parameters, such as drought frequency and intensity.

The issues summarised above variously affect calculation of trends in additional parameters, such as in specific humidity, wind, sunshine, etc.

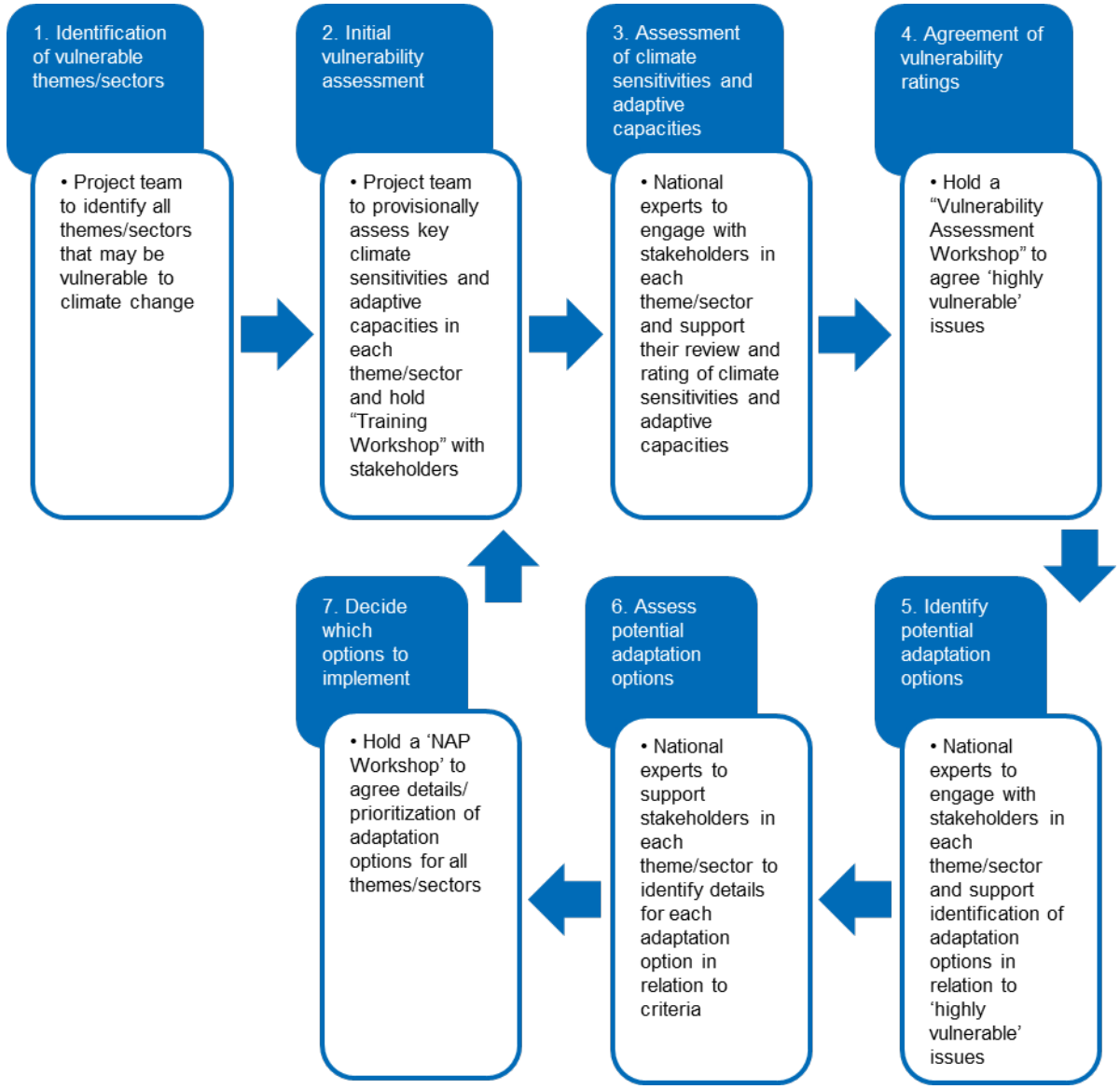
In order to embrace the difficulties and uncertainties related to identifying trends for the various parameters analysed, the NAP's Appendix 1 uses the terminology for likelihood and confidence from the IPCC AR5 and offers mirror images of confidence statements in order to provide a balanced presentation.

4.1.2 Vulnerability assessment

The process for assessing vulnerabilities and identifying adaptation options (Figure 37) built on the UNFCCC's guidelines for least developed countries[115] and the Climate Change Adaptation Strategy and Program of Action for the Palestinian Government[116].

[115] Least Developed Countries Expert Group, 2012. National Adaptation Plans. Technical guidelines for the national adaptation plan process. UNFCCC.
[116] UNDP, 2010. Climate Change Adaptation Strategy and Program of Action for the Palestinian Authority.

Figure 37: The process agreed for assessing vulnerabilities and identifying adaptation options



Issues, in part revealed by the Climate Change Adaptation Strategy and Program of Action for the Palestinian Government, that helped to define the process include:

- Water and food security having previously been identified as the most vulnerable issues in the State of Palestine with knock-on implications for all other sectors
- Climatic vulnerability in the State of Palestine being dwarfed by existing non-climatic vulnerabilities
- The West Bank including East Jerusalem and the Gaza Strip facing similar and differing vulnerabilities
- A need to embrace climatic uncertainties
- A lack of quantitative data relevant to the identification and prioritization of vulnerabilities and adaptation options
- The need to ensure common understanding and commitment amongst key stakeholders.

The process was agreed at initial workshops with stakeholders in the West Bank and the Gaza Strip (NAP Appendix 2) from across 12 themes/sectors (Box 1), which were identified as potentially vulnerable (Figure 37, Stage 1).

Box 1: Sectors or themes identified as potentially vulnerable to climate change

- Agriculture
- Coastal and marine
- Energy
- Food
- Gender
- Health
- Industry
- Terrestrial ecosystems
- Tourism
- Urban and infrastructure
- Waste and wastewater
- Water

It was agreed with stakeholders that an assessment of potential vulnerabilities (biophysical and/or socioeconomic) associated with each of the 12 themes/sectors should initially be drafted by a project team of national experts guided by an international expert. Definitions of terms used were consistent with the IPCC AR5, as follows:

Sensitivity – *'The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise)'.*

Adaptive capacity – *'The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences'.*

Vulnerability – *'The propensity or predisposition [tendency] to be adversely affected'.*

The inter-relations between these terms are illustrated in (Figure 38 below).

The draft assessments addressed the West Bank including East Jerusalem and the Gaza Strip separately. Climate sensitivities and adaptive capacities (with and without Israeli occupation) were identified and described in relation to each potential vulnerability. All relevant references were cited.

"Training Workshops" were then held in the West Bank and the Gaza Strip with stakeholders from each of the themes/sectors to familiarise them with the definitions of terms and the spreadsheet used for the assessment. Following the workshop, the draft vulnerability assessments were distributed to the stakeholders. They subsequently met in their thematic/sectoral groups in the West Bank and the Gaza Strip with a member of the project team. Each group reviewed and amended, where appropriate, the relevant list of potential vulnerabilities, the descriptions of climate sensitivities and adaptive capacities. They then rated each of them according to the scoring system set out in Table 23 and Table 24 below.

Figure 38: Illustration of inter-relations between definitions of terms used in IPCC's 5th Assessment Report

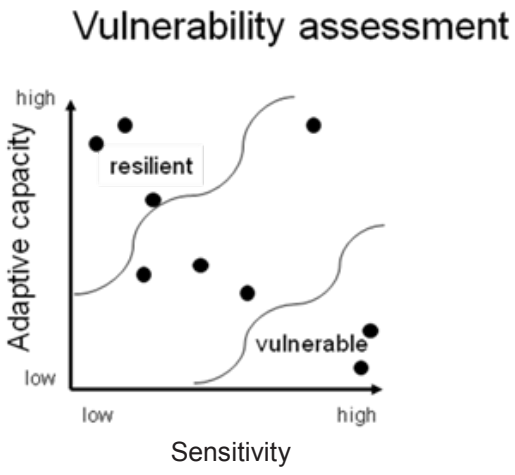


Table 23: Definitions for rating climate sensitivities

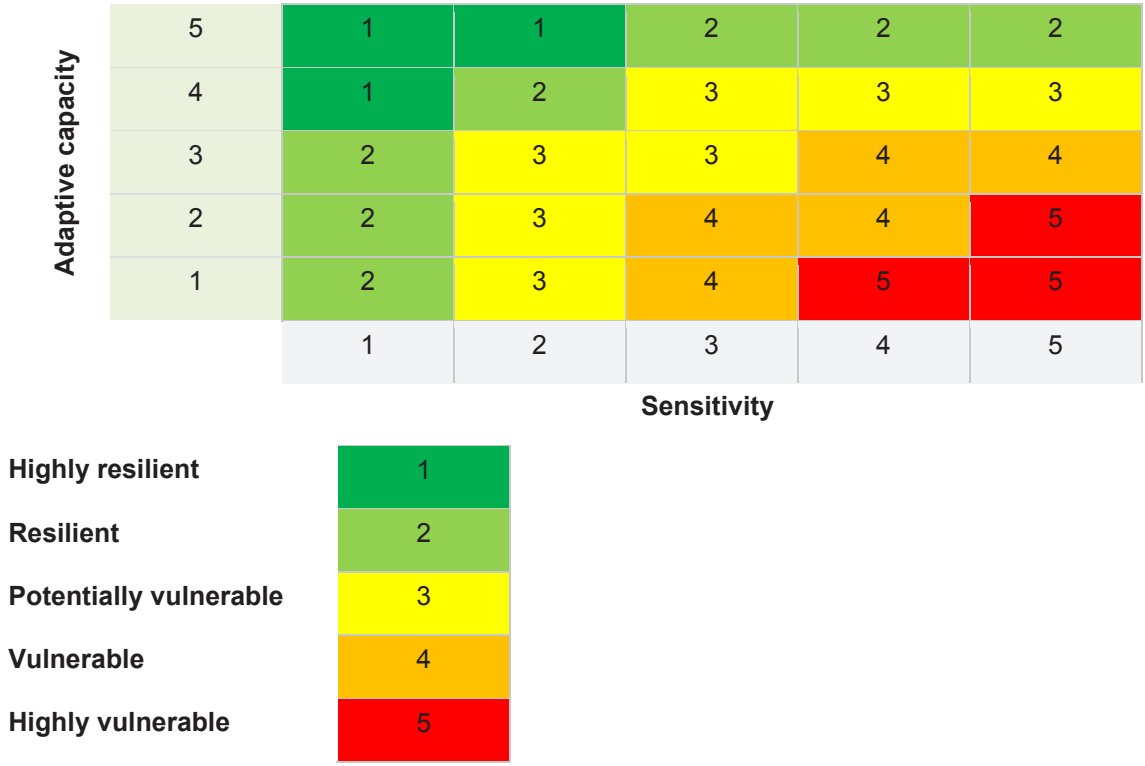
Rating	Definition
1	Will not be adversely affected
2	Unlikely to be adversely affected
3	Will be affected
4	Will be severely affected
5	Will become unmanageable

Table 24: Definitions for rating adaptive capacities

Rating	Definition
1	Unable to adapt without substantially increased support and resources
2	May be unable to adapt without increased support and resources
3	Should be able to adapt but will face challenges
4	Able to adapt but will face minor challenges
5	Able to adapt without problems

The ratings for climate sensitivity and adaptive capacities in relation to each of the potential vulnerabilities was then inter-related using the matrix in Figure 39 to provide a vulnerability rating (with and without Israeli occupation).

Figure 39: Vulnerability ratings



The resultant vulnerability assessments for all themes/sectors in the West Bank including East Jerusalem and the Gaza Strip were quality assured by the project team's international expert. The stakeholders from across all 12 themes/sectors then reconvened for 'Vulnerability Assessment Workshops' (i.e. Figure 37, Stage 4) held in the West Bank and the Gaza Strip. Those issues rated as 'highly vulnerable' under Israeli occupation were reviewed and agreed at the workshops, as the focus for identification and prioritization of adaptation options. Securing agreement demanded recalibration of scores for a small number of issues to ensure parity across themes/sectors. Focusing the NAP solely on 'highly vulnerable issues makes the NAP more conservative and realistic, and reduces the effect of uncertainties in determining priorities.

4.1.3 Provision of future-climate scenarios for the State of Palestine

Future-climate scenarios for the State of Palestine have been developed by an international expert in order to aid identification and prioritization of adaptation options in relation to the 'highly vulnerable' issues. High-quality future-climate scenarios may be desired in order to ensure that adaptation planning is well-focused and to avoid maladaptation insofar as possible. However, developing such scenarios is not straightforward. The assessment of historic trends in climate demonstrates that it is not a simple process to determine changes in the climate from historical data, especially for parameters such as rainfall. When trying to establish future-climate scenarios such difficulties are compounded by the uncertainties inherent in climate models used for projections and uncertainties regarding future concentrations of greenhouse gases (GHGs) in the atmosphere, land-use change (particularly reduction in the area of tropical forests) and the future extent of mitigation actions taken by the international community.

In order to provide climate-change scenarios for the State of Palestine based on the latest science, relevant scenarios presented in the literature have been reviewed to provide context for an analysis of projections from models used in the IPCC AR5 (NAP Appendix 3). The background review is presented in two parts:

1. A review of available official perspectives on future climate change submitted in National Communications (NCs) to the UNFCCC from countries in the vicinity of the State of Palestine (i.e. Lebanon, Jordan, Israel and Egypt)
2. A review of selected perspectives identified from a literature search of peer-reviewed journals and the grey literature.

The NCs perspectives of future climate change are consistent in expecting temperatures to increase. However, the range of temperature increase differs from less than 2°C to 4°C by the end of the century. These differences are to a major extent dependent upon the approaches taken. Most of the NCs anticipate reductions in rainfall; some by a few per cent, others by a substantial amount. Model results presented in the Egypt Second NC, albeit with relatively early generation climate models, illustrate the opposite possibility of substantial future increases in rainfall. There are some positions taken with respect to other aspects of rainfall, which would all lead to negative impacts, e.g. more droughts and floods, longer drought periods, and less daily rainfall but higher intensity falls leading to stronger floods.

The literature search of peer-reviewed journals and grey literature identified a range of perspectives on future climate change that are relevant to the State of Palestine. There is unanimity that temperatures will increase, although there is some disagreement by how much. Most analyses suggest future decreases in rainfall, although the amount of the decreases is somewhat uncertain. Nevertheless, one or two analyses suggest the possibility that rainfall may increase. In general, the contention is that the overall water situation will deteriorate, with more potential for drought and floods, increased evaporation, reduced river flow, etc., in line with the majority of positions in the NCs. However, where climate models are used, all analyses are based on limited numbers of projections, either one or just a few, rather than the much larger ensembles available to the IPCC.

The assessment of future-climate scenarios reviewed issues for climate projections of limited areas. The only viable approach available for assessing climate change is through the use of mathematical models, run on powerful computers, which simulate the climate over future decades. In order to run climate models, information is needed on future atmospheric GHG concentrations, which is provided through emissions scenarios or Representative Concentration Pathways (RCPs). However, no two models, or versions of a single model, will produce identical projections. Any differences in projections provided by the various climate models using a particular scenario or RCP can be traced predominantly to the way in which each model has been formulated. Relatively small changes to the structure of a

model may have a disproportionately large impact on the projections produced. Thus, with numerous climate models, or their variants, being used to produce an ensemble of individual projections, none the same, there is an issue of how to interpret the broad spread of information produced. Several approaches have been used. At the simplest level a preferred model is used, however, there is no evidence to guide appropriate selection and predictability theory is clear in indicating the limitations of this approach. At the next level a small number of preferred models are used from the complete ensemble. However, there is no more justification in predictability theory for selecting a subset of models than there is for selecting a single model. Nevertheless, both approaches are used frequently in published papers, adaptation planning and NCs to the UNFCCC, including some reviewed here. The only approach that begins to satisfy predictability theory is to create and interpret as large an ensemble of models as possible. There are various ways of doing so. The main one used by the IPCC is to use all available models from the various climate modelling centres. Most of the NCs or documents reviewed in this assessment use much smaller ensembles than the IPCC.

The methodology used to provide climate-change scenarios for the State of Palestine incorporated two main steps:

- A background assessment of climate change projections for the State of Palestine, calculating ensemble means for the atmosphere/ocean models used in the main IPCC AR4 and AR5 assessments, repeated for the AR5 using the projections from Regional Climate Models (CORDEX[117]) covering the Levant
- A detailed assessment of projections using the AR5-set based on the technique of self-organizing maps (SOMs).

The NAP's Appendix 3 notes that there are scientific issues still to be resolved with the regional models and, at this stage, it was considered appropriate only to use these as information rather than to exploit their enhanced temporal and spatial details.

Analyses have been prepared by year for 2016-2035 (summarised as 2025), 2046-2065 (2055) and 2081-2100 (2090) with changes calculated against simulations for each model for a historical period, 1986-2005. The assessment focused presentation of results on two of the four scenarios considered by IPCC AR5: RCP2.6 and RCP6.0 (the larger the value at the end of each 'RCP' the higher are the emissions and atmospheric GHG concentrations), although results for the other two RCPs (RCP4.5 and RCP8.5) are included in the NAP's Appendix 3.3. Separate scenarios under all four of the (RCPs) for the State of Palestine are also presented in the NAP's Appendix 3.4 for ease of comparison. The reasons for focusing on RCP2.6 and RCP6.0 were that:

- RCP2.6 is the only AR5 scenario that provides a high probability of achieving the UNFCCC target of a maximum average global temperature rise of 2.0°C, and
- RCP6.0 is a realistic option should UNFCCC processes fail given reasonable expectations of international mitigation activities.

A standard approach to interpreting the projections was used initially, i.e., an examination of ensemble means, their standard deviations, and ranges. However, the key additional step followed was to calculate SOMs. This is a technique to identify groupings within a dataset without assuming any statistical distributions (such as a normal distribution). Each grouping was then plotted on a scatter chart illustrating the complete temperature/rainfall projections, together with a companion chart showing the average temperature or changes associated at each time period with that particular group. Examination of the scatter charts typically suggests either a sequence of events in time, or, on occasions, individual groupings of models; the key aspect being that each model in each group is projecting similar future temperature and rainfall conditions. While this approach provides additional insight in comparison with the standard approach, both suffer from the same issues that lead to uncertainties:

- More outlying projections are taken into account only as components of the mean (or each group mean), and
- There is the possibility that the "answer" lies outside the entire range of the ensemble.

Thus, the interpretation of SOMs provided is not necessarily the final solution but is consistent with a realistic perspective of the complete spread provided by each full ensemble and resulted in a total of

[117] The results from the Mediterranean North Africa, MENA, CORDEX projections have been used.

nine, somewhat overlapping, scenarios. From those nine scenarios, a summary of three scenarios that are representative and cover the full range of options was provided to aid identification and prioritization of adaptation options in relation to the 'highly vulnerable' issues.

4.1.4 Identification and prioritization of adaptation options

It was agreed with stakeholders at the initial workshops that identification and prioritization of adaptation options (Figure 37, Stages 5-7) should be undertaken by them rather than by the project team, as it not only required stakeholders' understanding of specific operational details but also the buy-in of those stakeholders responsible for implementation of options selected. Members of the project team provided the stakeholders in each theme/sector in the West Bank and the Gaza Strip with active support in order to help guide them through the process. They also helped stakeholders, where necessary, to make an initial identification and prioritization of adaptation options for stakeholders' review and amendment.

Stakeholders were advised that adaptation options should seek to reduce vulnerabilities by reducing climate sensitivity or increasing adaptive capacity, and that options might include management and operational strategies, infrastructural changes, policy adjustments or capacity-building. They were also guided that some options might involve adjusting (climate-proofing) current activities, while other options might be new, or require major transformations in operations. In addition, it was suggested that some options might be ecosystem-based, i.e. helping people adapt to the impacts of climate change through the conservation, sustainable management, and restoration of ecosystems.

Stakeholders were encouraged to identify adaptation options that embrace all three future-climate scenarios for the State of Palestine that are representative of all projections considered in the IPCC AR5. Such options will be beneficial whichever of the scenarios comes to pass.

The State of Palestine's particular circumstances mean that stakeholders agreed that there was a need to focus on identification of immediate, near-future adaptation options that address the 'highly vulnerable' issues under Israeli occupation. However, limited consideration was also given to medium- and long-term adaptation options that could be taken if Israeli occupation was resolved.

4.1.4.1 Prioritizing adaptation options

An Excel tool, with associated guidance, was prepared by the project team's international expert in order to provide stakeholders with a simple framework for qualitatively comparing the relative merits of adaptation options[118]. More comprehensive tools (such as cost-benefit analysis) could be used in the future to analyse measures when more quantitative data become available. Stakeholders were introduced to the Excel tool at the 'Vulnerability Assessment Workshops'.

Stakeholders were requested to identify at least one adaptation option in relation to each of the 'highly vulnerable' issues relevant to their theme/sector. It was emphasised that the wording of the adaptation option should be as specific as possible. Stakeholders were directed that if they identified more than one adaptation option for the same 'highly vulnerable' issue then they should complete a separate row for each adaptation option. Furthermore, if the same adaptation option related to more than one 'highly vulnerable issue' then they were asked to complete a separate line for each 'highly vulnerable' issue.

The Excel tool required stakeholders to provide a short description in a 'Performance Matrix' of each adaptation option in relation to the criteria detailed below. Stakeholders were requested to make these descriptions as specific as possible in order to ensure subsequent prioritization of the adaptation options was adequately informed and in order to facilitate their translation into future outline funding proposals. In addition, the 'Performance Matrix' required that each adaptation option was screened in relation to the following questions:

- Would the adaptation action still be required if Israeli occupation was to be resolved?
- Could the adaptation action be taken only if Israeli occupation was to be resolved?

Stakeholders were directed that they should only seek to score the adaptation options in relation to each of the criteria using the Excel tool's 'Appraisal' sheet once the 'Performance Matrix' had been completed for all adaptation options in relation to a theme/sector for the West Bank or the Gaza Strip.

[118] See also UNFCCC (2012): National Adaptation Plans. Technical guidelines for the national adaptation plan process. LDC Expert Group, 2012. Available at: https://unfccc.int/files/adaptation/cancun_adaptation_framework/application/pdf/naptechguidelines_eng_high__res.pdf

This was to ensure that adaptation options across each theme/sector for the West Bank or the Gaza Strip could be scored relative to one another in a systematic, transparent and repeatable way.

Criteria for describing and scoring each adaptation option

The criteria to which the 'Performance Matrix' and Appraisal' sheet related were as follows. Each criteria for each adaptation option within a theme/sector was given a relative score of 'Low' (1), 'Medium' (5) or 'High' (10). Criteria associated with co-benefits could also be scored as 'Negative' (-5).

- **Impact** (consequences or outcomes) – '*Effects on natural and human systems*'[119] – The magnitude of the potential 'impact' (i.e. if the adaptation option is not implemented), assessed by considering the nature of each 'vulnerability' in relation to its potential 'exposure' to climate change, i.e. as determined from consideration of the future-climate scenarios developed for the State of Palestine.
- **Efficacy** – The extent to which the adaptation option addresses all three climate change scenarios and their potential impact. 'No regrets' options have a positive impact even if climate change is not as anticipated.
- **Timing/urgency for action** – The most urgent actions are those where delay could lead to greater impact (due to the speed of impact and/or time for the adaptation option to become effective, e.g. tree planting to provide shade or shelter that will not be provided until the trees mature) and/or increased costs.
- **Social acceptance** – The extent to which Palestinians will support and/or implement the adaptation option.
- **Technology –** The extent to which the technology to implement the adaptation option is readily available.
- **Knowledge and skills** – The extent to which the skills and knowledge to implement the adaptation option are readily available.
- **Costs** – The financial costs associated with design and implementation of the adaptation option, including operational costs (e.g. human resources) and investment costs, broken down into Years 1-5 and Years 6-10, where possible. High costs were scored as 'Low' whereas low costs were scored as 'High'. Table 25 provides a list of prompts, which were intended to aid stakeholders' consideration of the scale of costs associated with each adaptation option.

Table 25: Prompts to aid consideration of the scale of costs

Issue	Prompt
Scope	• What is the nature of the adaptation option (e.g. does it require implementation of management and operational strategies, infrastructural changes, policy adjustments or capacity-building)? • Who or what does the adaptation option focus on (e.g. if it is focused on farmers, how many does it target; all farmers or only in one geographic area)? • Are there any existing related projects with established budgets that might inform an estimate of costs?
Type	• Does the adaptation option need to be preceded by a feasibility study? • Will the adaptation option require a one-off capital investment and/or a series of investments, e.g. annually (N.B. some adaptation options will not involve capital costs, e.g. an awareness-raising campaign might only involve operational costs)? • What are the operational costs associated with the adaptation option, including maintenance and human resources?
Timing	• How does the time horizon for the adaptation option impact on its costs?

[119] IPCC (2013) Fifth Assessment Report

- **Co-benefits for adaptation in other themes/sectors** – The extent to which the adaptation option delivers potential co-benefits for adaptation by other themes/sectors, including contributing to National Development Plan goals. It was important when scoring this criterion to focus on the adaptation options most important implications for other themes/sectors (N.B. this criterion could have a negative score, i.e. some options could potentially increase other themes/sectors' vulnerabilities by increasing their climate sensitivity or reducing their adaptive capacity).
- **Co-benefits for mitigation** – The extent to which the adaptation action will reduce greenhouse gas (GHG) emissions (N.B. this criterion could have a negative score, i.e. some options could actually increase GHG emissions).

These criteria and associated scoring system were agreed with stakeholders at the 'Vulnerability Assessment Workshops'. A concern was expressed that inclusion of 'Costs' would unduly bias rankings and that they might be better considered separately. However, as 'Costs' contribute to only c.10% of the total possible score for each adaptation option, it was agreed to retain them within the scoring system. Consideration was also given to weighting each criterion to reflect the relative importance of its overall contribution to the ranking but this was not pursued, as unweighted scores were perceived to promote greater transparency.

Ranking of adaptation options

Once the Excel tool was completed for each theme/sector, the 'Results' sheet then automatically provided a total score and ranking of all options in descending order of priority for each theme/sector in the West Bank and the Gaza Strip. Stakeholders were directed to use the total scores and ranking as a means of checking for consistency of scoring of all adaptation options within their theme/sector. In some instances, stakeholders had preconceived expectations of where particular adaptation options should appear in the rankings, which were inoculated by their prioritization in existing thematic/sectoral strategies or plans. Where such expectations were not met, stakeholders were directed not to simply amend the scores in the 'Appraisal' sheet but, first, to review descriptions systematically in the 'Performance Matrix and revise wording and subsequent scores in relation to individual criteria, if appropriate. Where this could not be justified, stakeholders were advised that this suggested that it was existing thematic/sectoral strategies or plans that needed to be updated to be aligned with the NAP rather than the other way around.

The resultant assessments of adaptation options for all themes/sectors in the West Bank and the Gaza Strip were quality assured by the project team's international expert. The stakeholders from across all 12 themes/sectors then reconvened for 'NAP Workshops' (i.e. Figure 37, Stage 7) held in the West Bank and the Gaza Strip at which it was agreed that:

1. All adaptation options identified in relation to 'highly vulnerable' issues should be included in the NAP, irrespective of their ranking
2. It would be inappropriate to compare the priority of adaptation options between the West Bank and the Gaza Strip or between themes/sectors, as relative scores have been used to rank options within each theme/sector.

4.1.5 Requirements for Palestinian institutions to participate in climate-change modelling research

The international expert who developed the future-climate scenarios for the State of Palestine, required in order to aid identification and prioritization of adaptation options in relation to the 'highly vulnerable' issues, also provided a review of requirements for the State of Palestine to have the capability to generate its own climate modelling inputs to its future NAPs and NCs (NAP Appendix 5). The review assumed, for simplicity, that no resources to meet these requirements exist currently in the State of Palestine. Clearly that is not the case, however, a presentation in this form was intended to enable the State of Palestine to select the appropriate entry level in relation to each of the areas noted, which are.

- A comprehensive and readily accessible digitised database of ongoing weather and climate observations to World Meteorological Organization (WMO) standards
- Similar databases to fulfil requirements for hydrological parameters
- Appropriately-qualified staff

- Computer resources.

Resultant costings for inclusion in the NAP were provided by the Palestinian Meteorological Department.

4.2 Historic trends in climate

In summary, the assessment of historic trends in climate in relation to the State of Palestine, which was intended to provide a context for considering the climate sensitivity of potential vulnerabilities, reached the following conclusions in relation to climate variables:

- **Average temperature:** There is *very high* confidence that temperatures have risen over the past 100 years or so but less confidence in assessed quantitative rates of change because of spatial and temporal dependencies and issues of data quality. Nevertheless, there is *medium* confidence that the average temperature increased by 1°C over the 19th century but also *medium* confidence that the rate of increase was highest in the final 20 years of the century
- **Maximum and minimum temperatures and diurnal temperature stage:** There is *very high* confidence that maximum and minimum temperatures have increased and *high* confidence that the number of warm days and nights has increased since 1950. However, only *low* confidence for any changes in diurnal temperature ranges.
- **Temperature extremes[120]:** The different signs in the trends of the two global analyses of warmest day of the year illustrate the difficulties in providing stable assessments for the State of Palestine. Otherwise the available, but rather limited, evidence does provide partial support the contention of longer warm spells and shorter cold spells but *high* confidence that warm days/nights and cold days/nights have increased/decreased respectively in frequency.
- **Rainfall totals:** Some regional authors have argued that rainfall has decreased, however, not all authors agree. Taking all of the evidence into account, the interpretation of local rainfall trends, and perhaps even more so of rainfall extremes, should be treated with caution, despite the substantial number of analyses available. Thus, there is *very low* confidence that annual and seasonal rainfall totals have changed in either direction over the past 50 years or so but also *very low* confidence that there has been no change in annual and seasonal rainfall totals.
- **Rainfall extremes and other related parameters**: Only *very low* confidence can be ascribed to changes in rainfall extremes because of the limited evidence combined with the relative rarity of such events. The IPCC AR5 notes that it is *very likely* that specific humidity has increased since the 1970s, a result reflected in the Jordanian and Egyptian National Communications. On a global scale, the IPCC AR5 states that confidence is *low* for any changes in drought intensities or frequencies but notes that these are *likely* to have increased in the Mediterranean. Some of the results presented for the Levant appear consistent with the statements of the IPCC, while others do not.
- **Oceanic parameters:** The only oceanic parameter for which any number of analyses has been obtained in the region of interest has been sea level. With the complexity of the Mediterranean system, sea level rises in the basin do not necessarily follow those of the global ocean and do appear to be variable in time. Equally, the limited evidence on sea-surface temperatures suggests variability in time.

Full conclusions from the assessment of historic trends in climate can be found at the NAP's Appendix 1.

4.3 Vulnerabilities: 'Highly vulnerable' issues

Those issues rated as 'highly vulnerable', which stakeholders agreed should be the focus for identification, prioritization and implementation of adaptation options are listed in Table 26 and are

[120] IPCC AR5: "An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season)." In this document the word "extreme" is used with caution, not to imply any impact but only within the context of the IPCC definitions listed in the NAP's Appendix 1.3.

described below. The complete vulnerability assessments for all themes/sectors in relation to the West Bank and the Gaza Strip are available on request from EQA.

Table 26: Issues ranked as "Highly vulnerable"

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

4.3.1 Agriculture (West Bank) – 'Highly vulnerable' issues

General climate sensitivity and adaptive capacity

Agricultural production is sensitive to climate and local weather forecasts do not accurately predict heat waves, frosts or flash flood. Low rainfall postpones planting dates, and low temperatures delay maturation and harvesting. The Ministry of Agriculture (MOA) established an agricultural compensation fund, however, this is not yet active and compensation is limited to greenhouses and in some cases to irrigated vegetables, such as zucchini in the Jordan Valley, due to frost and/or hail storms. There is a lack of subsidies for farmers, as the State of Palestine is facing a fiscal crisis. Production of olives, grapes, stone fruits, rain-fed vegetables and field crops requires long-term water harvesting systems (and land management, including soil conservation practices, e.g. stone wall terracing etc). Technical

solutions are available and applicable in the West Bank, although technical and technological support is needed and financial resources are restrictive. Agricultural extension, awareness-raising and training programs are being implemented by the MOA on farm management and the need to modify practices in order to address the adverse impacts of climate change, including how to cope during drought periods. The capacity of storm water drainage systems to drain excess water during flood events is limited. The amount of labour involved in harvesting, packing, and marketing, depends on the amount of production. Current post-harvesting storage techniques are inadequate, e.g. there is a lack of large-scale grading and refrigerated cold storage.

Israeli occupation reduces the ability of producers to respond to any consequences of climate change. Land continues to be confiscated for the benefit of the Israeli Illegal Settlements Regime and the Annexation and Expansion Wall impinges on land management. The Wall has a damming effect with consequent negative impacts on soil and consequent agricultural production. There are restrictions on digging new wells for irrigation purposes and Israel confiscates much of the State of Palestine's ground water in the West Bank. Land reclamation and rehabilitation is restricted, especially in Area C, including opening of new agricultural roads, construction of stone terraces to minimize erosion and digging new water wells for irrigation. Confiscation and closure of access to large swathes of land heightens pressures on the land to which Palestinians retain access, encouraging overgrazing and intensive farming practices, and making it difficult to plan and execute sustainable land management schemes. Access to the international market is limited, as there are restrictions on import of fertilizers (e.g. urea), basic agricultural inputs and spare parts, which increases the cost of agricultural production, as well as restrictions on exports of crops to neighbouring countries. The 2009 World Bank report on the State of Palestine's water sources indicates that removal of Israeli restrictions and provision of additional water would increase the agricultural sector's contribution to GDP by 10% and create approximately 110,000 new jobs.

Additional elements of climate sensitivity and/or adaptive capacity specific to individual 'highly vulnerable' issues are detailed below.

4.3.1.1 Production of olives, grapes, stone fruits, irrigated vegetables and field crops[121,122,123,124,125,126,127,128,129]

Climate sensitivity

The olive tree is a national symbol. Olive production is sensitive to frost, heat waves, drought, wind speed, amount and distribution of rainfall, and hail. In 2010, heat waves during the flowering season reduced olive production by 20%. Grape production is more climate sensitive than olive production, particularly to frost, hail, drought, and rainfall patterns (amount and distribution). In 2015, frost destroyed production of 170 hectares (3,825 tons), and partially destroyed 300 hectares (3,750 tons) in Hebron and Bethlehem Governorates. At Beit Umar (a town in Hebron Governorate), expected weather-related losses in grape production during 2015 were c.4,500 tons. Field crops are sensitive to drought, amount and distribution of rainfall, and heat waves. Irrigated vegetables are sensitive to frost, drought, high temperatures, and wind speeds of more than 80 km/h. Greenhouses are sensitive to heavy snow, high wind velocity, and very low temperatures. Heavy snow and high wind speed damage the foundations of greenhouses and their plastic covers. In very low temperatures, crops will freeze and losses can result directly from damage or death of plants. Planting and harvesting dates of field crops and rain-fed

[121] World Bank. (2013) Area C and the future of the Palestinian economy. Poverty reduction and economic management Department Middle East and North Africa Region, Report No. AUS2922.
https://openknowledge.worldbank.org/bitstream/handle/10986/16686/AUS29220REPLAC0EVISION0January02014.pdf?sequence=1
[122] Ma'an News Agency. (2010). Heat waves hit olive crops in Palestine (Arabic report).
www.maannews.net/arb/ViewDetails.aspx?ID=304225
[123] PCBS. (2011) Agricultural Statistics Survey, 2010/2011. Palestinian Central Bureau of Statistics, Arabic version. July 2012.
http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/159/download/407
[124] Shaheen, H.; and Karim, R.A. (2007) Management of olive-mills wastewater in Palestine. An-Najah University Journal for Research (Natural Sciences) Vol. 21. P 63-83.
[125] Ma'an News Agency. (2015) Hebron grapes in danger, Arabic report.
https://www.maannews.net/Content.aspx?id=775427
[126] World Bank. (2015) Economic monitoring report to the Ad Hoc Liaison Committee.
http://documents.worldbank.org/curated/en/2015/05/24525116/economic-monitoring-report-ad-hoc-liaison-committee
[127] Hona alquds. (2015) Frost waves hurt crops in Jordan Valley. (Arabic report).
http://honaalquds.net/ar/article/8816/#.VVjOtPkirIU
[128] MOA. (2016) National Agriculture Sector Strategy, 2014-2016: Resilience and Development, Ministry of Agriculture, State of Palestine.
http://reliefweb.int/sites/reliefweb.int/files/resources/1417423273.pdf
[129] World Bank. (2009) Assessment of restrictions on Palestinian water sector development, West Bank and Gaza report. Report No. 47657-GZ.
http://siteresources.worldbank.org/INTWESTBANKGAZA/Resources/WaterRestrictionsReport18Apr2009.pdf

vegetables are sensitive to climate. Low rainfall postpones the planting date, and low temperatures delay maturation.

Adaptive capacity

Olive trees in the State of Palestine comprise 71.6% of trees and c.15-19% of total agricultural production. Israeli settlers uproot, burn and destroy olive trees, as well as releasing wild pigs, which damage olive seedlings. Access to olive groves is restricted, where they are close to Israeli settlements and military bases. Olive oil degrades in quality while awaiting Israeli permission for export to the Arab Gulf and international markets. About 8,000 hectares is cultivated for grape production and contributes about 12% of total agricultural production. The MoA distributes seeds of field crops (e.g. wheat and barley) that are drought-tolerant. The Palestinian Government is trying to increase the number of jobs through establishing agro-industrial zones, such as Jericho and Jenin. USAID thankfully established several packing and grading houses in the Jordan Valley for high value cash crops (dates, cherry tomatoes, peppers, and herbs).

4.3.1.2 Grazing area and soil erosion[130,131,132,133,134]

Climate sensitivity

The grazing area on the eastern slopes is the most sensitive to climatic conditions. Overgrazing, low rainfall and drought combine to reduce vegetation cover, species-richness and productivity, and increase wind erosion, rangeland fires and the spread of invasive plant species. Loss of vegetation makes soils sensitive to gully erosion resulting from intense rainfall events and flash floods, which can remove a substantial amount of fertile topsoil.

Adaptive capacity

While rangeland amounts to 2.02 million dunums (1 dunum = 0.1 ha), the area available for grazing is only 621,000 dunums. There is an absence of grazing regulations (open and close season). The MoA is undertaking several reforestation projects to protect soils from erosion.

4.3.1.3 Irrigation water[135,136,137]

Climate sensitivity

Irrigation water is sensitive to rainfall amount and distribution, and shifts in the rainy season. Drought decreases the quantity of water that can be allocated to agriculture yet at the same time increases crops' water requirement, increasing costs of production (inclusive of electricity for pumping).

Adaptive capacity

Irrigation water is supplied by groundwater wells and springs. In 2011, 60 million m^3 of water was available for agriculture. Irrigation infrastructure is old and inefficient, under-developed or undeveloped. Irrigation practices are outdated and there is a need to introduce precision agriculture and drip irrigation. Israeli occupation has led to inadequate infrastructure for treating Palestinian wastewater that could be used in irrigation, as: approval of plans for building treatment plants has been delayed (in some cases for more than a decade); Israel has demanded that the State of Palestine should connect settlements to the planned treatment plants (which has been rejected for political reasons); and Israel has forced Palestinians to employ treatment standards more advanced than those generally used in Israel, which

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[130] MOA. (2016) National Agriculture Sector Strategy, 2014-2016: Resilience and Development, Ministry of Agriculture, State of Palestine. http://reliefweb.int/sites/reliefweb.int/files/resources/1417423273.pdf

[131] Mason, M.; and Mimi, Z. (2014) Transboundary climate security: climate vulnerability and rural livelihoods in the Jordan River Basin, London School of Economics and Political Science Birzeit University. Final Project Report. http://www.lse.ac.uk/middleEastCentre/publications/Reports/TSCReport.pdf

[132] Abu Hammad, A. (2011) Watershed erosion risk assessment and management utilizing revised universal soil loss equation-geographic information systems in the Mediterranean environments. Water and Environment Journal, Vol 25, Issue 2, 149–162.

[133] Dudeen, B (2011) The soils of Palestine (The West Bank and Gaza Strip) current status and future perspectives. In, Soil resources of Southern and Eastern Mediterranean countries. CIHEAM, 203-225.

[134] World Bank. (2015) Economic monitoring report to the Ad Hoc Liaison Committee. http://documents.worldbank.org/curated/en/2015/05/24525116/economic-monitoring-report-ad-hoc-liaison-committee

[135] World Bank. (2013) Area C and the future of the Palestinian economy. Poverty reduction and economic management, department Middle East and North Africa Region, Report No. AUS2922. https://openknowledge.worldbank.org/bitstream/handle/10986/16686/AUS29220REPLAC0EVISION0January02014.pdf?sequence=1

[136] PCBS. (2011) Agricultural Statistics Survey, 2010/2011. Palestinian Central Bureau of Statistics, Arabic version. July 2012. http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/159/download/407

[137] EQA. (2010) The impact of annexation and expansion wall on the Palestinian environment. Environment Quality Authority, Palestinian National Authority. http://www.lacs.ps/documentsShow.aspx?ATT_ID=6057

has increased the cost of plant construction. Israel also places restrictions on Palestinians building power plants and desalination plants.

4.3.1.4 Livestock production[138,139,140]

Climate sensitivity

Heat and cold waves reduce productivity in cattle and poultry, cold waves reduce the amount of milk production. Sheep are sensitive to cold (new-borns and small lambs). Adult sheep are sensitive to heat waves (during the fertilization period). The cost of agricultural production increases in climatic extremes, for example, as a result of heat waves, there may be a requirement for more electricity for cooling in livestock barns.

Adaptive capacity

Most raw materials and fodder are imported, which increases the cost of production. Israel places restrictions on importing livestock, such as dairy cows for milk production and poultry (broilers and layers). Israel floods the State of Palestine's markets with Israeli products, such as chickens and eggs, which is destroying the country's economy. There are limited financial resources to establish large-scale intensive livestock farms or to install large-scale granaries. The latter could reduce the cost of fodder production. Granaries are a government responsibility.

4.3.2 Agriculture (Gaza Strip) – 'Highly vulnerable' issues

Agriculture's climate sensitivity in the Gaza Strip is often the same or similar to the West Bank, as is the adaptive capacity of systems, institutions, people, and ecosystems to respond. Hence, the two geographic areas share a number of 'highly vulnerable' issues in common for which details above are relevant: livestock production; production of olives and vegetables; irrigation water. However, fishing and fisheries is an additional 'highly vulnerable' issue in the Gaza Strip and there is greater concern than in the West Bank that the cost of agricultural production is 'highly vulnerable'. The situation in Gaza is compounded by the high number of agricultural facilities (e.g. livestock barns and greenhouses) that have been destroyed by Israeli air strikes during the last three wars (2008, 2012, and 2014)[141]. Further supplementary details specific to the Gaza Strip are provided below.

4.3.2.1 Livestock production[142,143,144]

Climate sensitivity

Livestock production's sensitivity to climate is the same as in the West Bank (see above). In May 2015, 15% of chickens in the Gaza Strip died as a result of a heat wave (12ºC above the annual average).

Adaptive capacity

Issues in relation to adaptive capacity are the same as in the West Bank (see above). Notably, there is the potential to develop and enlarge slaughterhouses in the Gaza Strip.

[138] World Bank. (2009) Assessment of restrictions on Palestinian water sector development, West Bank and Gaza report. Report No. 47657-GZ. http://siteresources.worldbank.org/INTWESTBANKGAZA/Resources/WaterRestrictionsReport18Apr2009.pdf.
[139] PCBS. (2011) Agricultural Statistics Survey, 2010/2011. Palestinian Central Bureau of Statistics, Arabic version. July 2012. http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/159/download/407
[140] Maan News Agency. (2015) Chickens death due to heat wave (Arabic report). https://www.maannews.net/Content.aspx?id=778289
[141] PASSIA Desk Diary (2015) Jerusalem: PASSIA, December 2014. http://www.passia.org/images/meetings/2015/Material%20for%20the%20Website/Economy%20%282015%29.pdf
[142] World Bank. (2009) Assessment of restrictions on Palestinian water sector development, West Bank and Gaza report. Report No. 47657-GZ. http://siteresources.worldbank.org/INTWESTBANKGAZA/Resources/WaterRestrictionsReport18Apr2009.pdf
[143] PCBS. (2011) Agricultural Statistics Survey, 2010/2011. Palestinian Central Bureau of Statistics, Arabic version. July 2012. http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/159/download/407
[144] Maan News Agency. (2015) Chickens death due to heat wave (Arabic report). https://www.maannews.net/Content.aspx?id=778289

4.3.2.2 Cost of agricultural production[145,146,147]

Climate sensitivity

The cost of agricultural production increases in response to climatic extremes, e.g., as a result of heat waves there may be a requirement for more: water for irrigation; shade-netting to minimize the impact of the sun; pest control; electricity for cooling in livestock barns.

Adaptive capacity

In 2008, the cost of agricultural production in the State of Palestine was USD490.4 million (25.1% for plant production; 74.9% for animal production). The cost of feed for livestock accounts for 58.9% of the total cost. There is a lack of agricultural subsidies due to the fiscal crisis that the Palestinian Government is facing. Currently, the MoA also has limited expertise to reduce the cost of agricultural production.

Adaptive capacity in relation to the cost of agricultural production is reduced by the State of Palestine's reliance on Israel for electricity and water and Israeli restrictions on: building Palestinian power plants and desalination plants; establishing a national fertilizer factory; and import of basic agricultural inputs and spare parts.

4.3.2.3 Production of Citrus, olives, and vegetables and employment[148,149,150,151,152]

Climate sensitivity

Citrus are sensitive to frost, which destroys the buds, young leaves, and flowers with consequent loss of fruit. Olives, rain-fed and irrigated vegetables are climate sensitive as described for the West Bank. Any shortage of rainfall will affect the area and type of agricultural production with likely resultant loss of employment.

Adaptive capacity

In 2009, the area of Citrus extended to 15,812 dunums (producing 36,028 tons of fruit), however, it has declined considerably from 72,000 dunums in 1980 and continues to do so for a wide range of reasons. Olive trees comprise 35% of all trees in the Gaza Strip and produce 5,000 tons of olive fruits per annum but are similarly in decline. Since 2000, Israel has bulldozed a large area of Citrus and olive trees and production costs have increased due to the Israeli siege. A dramatic increase in land values has also led to many Citrus farms and olive groves being converted to residential areas. In addition, there are restrictions on farming in the buffer zone parallel to the electrical fence. The shortage of agricultural land combined with a lack of regulation of what crops farmers choose to grow means that agricultural patterns have changed, and farmers are favouring high-value cash-crops, such as strawberries. There is also insufficient water to irrigate Citrus farms and olive groves during dry periods (see "Irrigation water" below).

In 2010/11, the area of rain-fed and irrigated vegetables in the Gaza Strip was 33,752 dunums producing 57,650 metric tonnes. It too has been hit by issues relating to the shortage of land and water.

Agriculture provides employment for 38,000 people in Gaza Strip. The Palestinian Government is trying to increase the number of jobs in the sector through establishing agro-industrial zones, such as the Gaza Industrial Estate. Currently, many donors and international agencies, in cooperation with the Palestinian Government, are implementing "work for food programs". Most of the issues limiting

[145] World Bank. (2009) Assessment of restrictions on Palestinian water sector development, West Bank and Gaza report. Report No. 47657-GZ. http://siteresources.worldbank.org/INTWESTBANKGAZA/Resources/WaterRestrictionsReport18Apr2009.pdf
[146] PCBS. (2011) Agricultural Statistics Survey, 2010/2011. Palestinian Central Bureau of Statistics, Arabic version. July 2012. http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/159/download/407
[147] Welfare Association (2009) Impact of Gaza crisis, Agricultural Sector Report. March 2, 2009 https://www.ochaopt.org/documents/opt_agri_fao_agrsect_impact_of_gaza_crisis_mar_09.pdf
[148] Al-Tabbaa, M. (2014) Gazan citrus disappeared from the market (Arabic report). March, 15, 2014. http://paltoday.ps/ar/post/187695.
[149] PCBS. (2009) Agricultural Statistics Survey for year 2007/2008. Palestinian Central Bureau of Statistics. http://www.pcbs.gov.ps/Downloads/book1620.pdf
[150] GNRD. (2011) Israeli enforcement of Buffer Zone Area in the Gaza Strip, "Most Important Violations Resulting from the Buffer Zone". Global network for rights and development (GNRD), Al-Dameer Association for Human Rights. http://www.gnrd.net/userfiles/cc/gaza.pdf
[151] World Bank. (2009) Assessment of restrictions on Palestinian water sector development, West Bank and Gaza report. Report No. 47657-GZ. http://siteresources.worldbank.org/INTWESTBANKGAZA/Resources/WaterRestrictionsReport18Apr2009.pdf
[152] PCBS. (2011) Agricultural Statistics Survey, 2010/2011. Palestinian Central Bureau of Statistics, Arabic version. July 2012. http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/159/download/407

adaptive capacity in relation to other 'highly vulnerable' agricultural issues also directly or indirectly affect adaptive capacity in relation to the sector's level of employment.

4.3.2.4 Irrigation water[153,154]

Climate sensitivity

Drought reduces the amount of water available for irrigation and increases crops' requirements for water.

Adaptive capacity

In 2011, 86 million m^3 of water was available for agriculture. Israel recognizes the State of Palestine's right to water but has reduced the quantity available for irrigation. Groundwater wells are the main source of water for irrigation in the Gaza Strip. Limited use is made of treated wastewater. Israel's obstruction or refusal to allow Palestinians to import and install wastewater treatment or desalination plants means that there is insufficient freshwater for irrigation during dry periods, and the ability of irrigation engineering to manage irrigation water resources is limited. Due to the Israeli siege, the power supply is frequently interrupted, which also impedes irrigation.

4.3.3 Coastal and marine (Gaza Strip) – "Highly vulnerable" issues

4.3.3.1 Fishing and fisheries, and fish catch[155,156,157,158]

Climate sensitivity

Most fish are found between 20m and 200m from shore, with the highest rate of abundance between 100m and 200m. However, as noted in relation to fishing and fisheries, higher temperatures encourage fish to move from warm, shallow coastal waters into cooler, deeper waters with potentially negative implications for the quantity and quality of the fish catch. Increasing levels of carbon dioxide in the atmosphere will also lead to acidification of seawater, which will dissolve the shells of some animals, and reduce the rate of survival and affect the behaviour of fish, with consequences for the fish catch.

Adaptive capacity

According to the UN, at least 95% of fishermen in the Gaza Strip rely on international aid to survive. The MoA estimates that the people of the Gaza Strip require around 10,000 metric tonnes of fish annually. However, the annual fish catch from all types of vessel is less than 2,000 metric tonnes. Approximately two-thirds of fish are landed in Gaza Governorate. There are no fish-processing plants, so if the amount of fish caught exceeds demand then fish prices are usually reduced. Fishing and fisheries also suffer from a lack of government subsidies and insurance.

According to the UN, Palestinian fishermen lost 1,300 metric tonnes of fish annually between 2000 and 2012, as a result of Israeli restrictions. Most notably, the fishing area has been reduced from the 20 nautical miles stipulated by the Oslo Agreement to 6 nautical miles, which is enforced by Israel. With 935 boats concentrated in 660km^2, resultant overfishing has led to diminishing populations of pelagic and, especially, demersal fish. The cost of fishing has been increased by Israeli restrictions on importing: fuel for vessels and cold storage basic; spare parts; and fishing inputs. Israeli restrictions on installation of wastewater treatment plants along the Gaza Strip mean that more than 50% of all wastewater (70-80,000m^3) is discharged from 16 sewage outfalls directly into the sea. This is polluting the fishing area and destroying the sector. Fishermen are also often intimidated and displaced by Israeli armed forces.

If Israel would agree to the State of Palestine's area of fishing being extended and to rehabilitation of Gaza's fishing port, then the latter could have the potential to be developed. However, there has been

[153] Welfare Association (2009) Impact of Gaza crisis, Agricultural Sector Report. March 2, 2009 https://www.ochaopt.org/documents/opt_agri_fao_agrsect_impact_of_gaza_crisis_mar_09.pdf
[154] B'Tselem. (2009) Water crisis in Gaza Strip: over 90% of water un-potable. http://www.btselem.org/gaza_strip/gaza_water_crisis
[155] PCBS (2012) Agriculture Statistics Survey, 2010/2011. Palestinian Central Bureau of Statistics - www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/159/download/407
[156] Omer, M., (2014) Gaza fishermen demand end to blockade. Al Jazeera English report http://www.aljazeera.com/news/middleeast/2014/08/gaza-palestinian-fishermen-israel-blockade-201489131718364341.html
[157] Maannews (2015) First Shrimp Farm in Gaza - Arabic report. Ma'an News Agency https://www.maannews.net/Content.aspx?id=780137
[158] OCHA (2009) Agriculture Sector Report - Impact of Gaza Crisis. United Nations Office for the Coordination of Humanitarian Affairs https://www.ochaopt.org/documents/opt_agri_fao_agrsect_impact_of_gaza_crisis_mar_09.pdf

a decline in the number of people involved in fishing from approximately 10,000 in 2000 to 3,500 in July 2013.

4.3.3.2 Coastal agriculture[159,160,161,162]

Climate sensitivity

Agricultural land amounts to about 43% of the coastal area and contributes 31% of the Gaza Strip's total agricultural production. Sea-level rise (currently 1.5mm per annum) will accelerate coastal erosion and increase saltwater intrusion affecting the nearest agriculture farms, especially on low-lying land.

Adaptive capacity

There is scope to use saline-tolerant crops that are able to cope with the conditions.

4.3.3.3 Condition of beaches[163,164,165,166]

Climate sensitivity

As noted above, sea-level rise will increase wave impact and accelerate coastal erosion thereby reducing the quality of tourist beaches, damaging harbors and other coastal structures, and potentially leading to collapse of the coastal beach cliff.

Adaptive capacity

Sensitivity to climate has been exacerbated by excavation of sand from coastal dunes. A total of 25 million m^3 is estimated to have been removed. This has reduced the dunes' functions to protect the coast from erosion, to purify water reaching the subsoil, and to provide wildlife habitat. Rocks have also been removed for construction. Israel restricts import of sand, rocks, and cement, which are required for implementation of beach protection measures.

4.3.4 Energy (West Bank) – "Highly vulnerable" issues

4.3.4.1 Domestic energy production[167,168]

Climate sensitivity

Domestic electricity production currently fulfils only 2% of demand (annual per capita electricity consumption 700kWh). Temperature extremes increase energy demands for heating and/or cooling. Currently, 70% of households use solar water heaters. The performance of such systems is climate-sensitive. Most feedstocks are imported, subject to Israeli permission. Small amounts of biomass from wood and waste, produced locally and used primarily for heating, are affected by the climate.

As there are no facilities to store feedstocks, the ability to produce domestic energy from feedstocks is sensitive to climate and is seasonally affected or if demand suddenly increases due to climate. There is limited ability to import large volumes of feedstocks in order to maintain a continuous energy supply when electricity from Israel is interrupted. In addition, systems for distributing feedstocks are inefficient

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[159] EQA (2010). Environment Sector Strategy. Environment Quality Authority
http://www.lacs.ps/documentsShow.aspx?ATT_ID=6056
[160] UNDP (2010), Climate Change Adaptation Strategy and Programme of Action for the Palestinian Authority. United Nations Development Programme - Programme of Assistance to the Palestinian People
http://www.lacs.ps/documentsShow.aspx?ATT_ID=6054
[161] UNDP (2010), Climate Change Adaptation Strategy and Programme of Action for the Palestinian Authority. United Nations Development Programme - Programme of Assistance to the Palestinian People
http://www.lacs.ps/documentsShow.aspx?ATT_ID=6054
[162] MEnA (2001), Gaza Coastal and Marine Environmental Protection and Management Action Plan prepared by Ministry of Environmental affairs, Palestinian National Authority.
http://s3.amazonaws.com/zanran_storage/smap.ew.eea.europa.eu/ContentPages/723959522.pdf
[163] EQA (2010). Environment Sector Strategy. Environment Quality Authority
http://www.lacs.ps/documentsShow.aspx?ATT_ID=6056
[164] UNDP (2010), Climate Change Adaptation Strategy and Programme of Action for the Palestinian Authority. United Nations Development Programme - Programme of Assistance to the Palestinian People
http://www.lacs.ps/documentsShow.aspx?ATT_ID=6054
[165] UNDP (2010), Climate Change Adaptation Strategy and Programme of Action for the Palestinian Authority. United Nations Development Programme - Programme of Assistance to the Palestinian People
http://www.lacs.ps/documentsShow.aspx?ATT_ID=6054
[166] MEnA (2001), Gaza Coastal and Marine Environmental Protection and Management Action Plan prepared by Ministry of Environmental affairs, Palestinian National Authority.
http://s3.amazonaws.com/zanran_storage/smap.ew.eea.europa.eu/ContentPages/723959522.pdf
[167] Yasin, B. (2013) Energy Efficiency Country Profile – Palestine 2012. Regional Centre for Renewable Energy and Energy Efficiency.
http://www.rcreee.org/sites/default/files/palestine_ee_fact_sheet_print.pdf
[168] Palestinian Central Bureau of Statistics, Statistics – Energy. http://www.pcbs.gov.ps/site/lang__en/886/Default.aspx

and are affected by extreme climate events. Notably, interruptions in electricity supply affect water pumping and wastewater treatment, especially during extreme weather events.

Adaptive capacity

The State of Palestine's energy strategy is to generate 50% of electricity consumed by 2020 and two 200MW power stations are planned in the North and South of the West Bank. The strategy also specifically sets a target of 20% from renewables by 2020. Solar energy has the greatest potential with daily average insolation of 5.4 kWh/m^2/day for both heat and electricity generation. However, other renewable energy sources, such as wind, geothermal and biomass are expected to play a role. It is estimated that there is potential to generate 20 MW from energy-from-waste (e.g. municipality solid waste, agriculture and some industrial waste), with high potential for gasification. There has also been a recent possible discovery of natural gas in West Bank.

The State of Palestine encourages import of feedstocks through Jordan whenever it is possible and can be offered feedstocks at reduced prices from Arab and other countries. Legislation and regulations (e.g. building standards and codes) are being adopted and energy conservation measures (e.g. green-building concepts) are being introduced to enforce and encourage energy efficiency and use of renewable energy.

Israel controls all energy resources in the West Bank and Israeli restrictions (e.g. on people's movement, and import of goods, technology and fuel) limit:

- Upgrading of the State of Palestine's electricity grid and establishing a national transmission line
- Building power stations in the West Bank
- The State of Palestine's ability to extract any natural gas
- The amount of renewable electricity that can be fed into the grid (at medium voltage)
- Import of feedstocks, including only granting import through Israeli agents and companies, and causing delays as a result of security, customs, standards and quality checking, with resultant impact on availability
- Importing of photovoltaics (PV) and other renewable energy systems hampering the rate of installation.

4.3.4.2 Energy imports[169]

Climate sensitivity

Changes to climate may increase energy demands for heating and/or cooling (e.g. as result of frosts or heatwaves). In order to fulfil domestic demand, 93% of electricity is imported currently; 89% from Israel and 4% from Jordan. All required petroleum products are imported through Israel.

Adaptive capacity

There is no security of electricity supply as Israel can and does cut it off. The State of Palestine's ability to adapt is limited because the electricity transferred, voltage type, and number of connecting points (feeders) are all determined by Israel. Upgrading of the State of Palestine's grid is subject to Israeli approval. Import of fuel from Jordan or other Arab countries is subject to permission from Israel. Israel also prevents storage of large amounts of petroleum and liquid petroleum gas (LPG) and development of a distribution system (pipe network) in the West Bank. Despite all of these restrictions, the electricity grid is being connected with Jordan in the Jericho region, so that electricity can be imported from Jordan, and a range of measures are being taken to promote domestic energy production (see above).

4.3.4.3 Condition of infrastructure

Climate sensitivity

The electricity high-voltage grid is weak and needs rehabilitation, so could be easily damaged during extreme weather conditions, for example, by storms. There are no national fuel pipelines and no power stations in the West Bank. Fuel tankers are affected by weather and road conditions.

[169] Regional Centre for Renewable Energy and Energy Efficiency (2009) Provision of technical support/services for an economical, technological and environmental impact assessment of national regulations and incentives for renewable energy and energy efficiency. Country report: Palestine. http://www.rcreee.org/content/country-report-palestine.

Adaptive capacity

There is a need to: establish a national high-voltage grid and upgrade the connection with Jordan; rehabilitate and update the existing electricity distribution systems to cope with additional electricity generated from renewables; build power stations; and develop fuel-storage facilities for diesel, gasoline and LPG. However, all are subject to Israeli approval and are usually prevented or delayed.

4.3.5 Energy (Gaza Strip) – "Highly vulnerable" issues

4.3.5.1 Domestic energy production[170,171,172,173,174]

Climate sensitivity

Climate changes may increase energy demand for heating, cooling, or desalination. Hence, as almost all houses are connected to weak electricity grids, any changes in the climate that increase the load on the grids could cause interruption in the electricity supply.

Adaptive capacity

The Gaza Power Plant (GPP) is the primary source of domestic energy production. Israel restricted the GPP's maximum generation capacity from 135 MW to approximately 90MW, which was further reduced to about 50MW (30% of total energy consumed) by an Israeli air strike in June 2006. Israel neither allows expansion of the GPP nor upgrading of the current equipment. Current use of renewable energy to meet any increased demand is limited due to the high investment costs, although approximately two-thirds of houses use solar water heaters. Many homes have their own electricity generators and households purchase fuel to run them, which is expensive. Lots of households own batteries to store electricity for lighting.

4.3.5.2 Energy imports[175]

Climate sensitivity

The State of Palestine is reliant on energy imports from Israel, which is an unreliable source, especially if climate changes lead to increased energy demands. Most electricity consumed is imported from Israel through the Israeli electricity company. The GPP requires 550,000 liters of fuel per day to maximise its generation of electricity and households purchase fuel to run their own generators. All petroleum products are imported through Israeli petroleum companies. This fuel is transported by tankers and, hence, the reliability of the supply is very sensitive to weather and road conditions.

Adaptive capacity

Most of the sources of energy required to fulfil demand are imported (currently, 121 MW from Israel and 33 MW from Egypt out of current total of 220 MW[176]) and, hence, subjected to strict Israeli regulation. The diversity of sources is restricted by Israel. Electricity is supplied and cut off by the Gaza Electricity Distribution Corporation at 6- to 8-hourly intervals. Israel restricts the regular supply and storage of fuel for running the GPP. It also prevents construction of the seaport, which could otherwise facilitate import of fuel.

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[170] PCBS (2010), Palestine - Household Energy Survey January 2010, Palestinian Central Bureau of Statistics, Palestinian National Authority, Reference ID: PSE-PCBS-HES-2010jan-V1.0
http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/57
[171] PCBS (2009), Energy Balance in the Palestinian Territory 2007, Palestinian Central Bureau of Statistics, Palestinian National Authority.
http://www.pcbs.gov.ps/Downloads/book1532.pdf
[172] Ouda, M. (2006), Energy Analysis Of Gaza Strip's Residential Sector, Islamic University of Gaza, Palestine.
http://site.iugaza.edu.ps/mouda/files/2010/02/ENERGY_ANALYSIS__GS_RESIDENTIAL.pdf
[173] PCBS (2010), Palestine - Household Energy Survey January 2010, Palestinian Central Bureau of Statistics, Palestinian National Authority, Reference ID: PSE-PCBS-HES-2010jan-V1.0
http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/57
[174] GISHA (2013), Restricted Import List Gaza Strip 2013
http://www.gisha.org/userfiles/file/LegalDocuments/procedures/merchandise/55en.pdf
[175] OCHA (2014), The Humanitarian Impact of Gaza's Electricity And Fuel Crisis, United Nations, Office For The Coordination Of Humanitarian Affairs, Occupied Palestinian Territory.
https://www.ochaopt.org/documents/ocha_opt_electricity_factsheet_march_2014_english.pdf
[176] Dmeri, F., PENRA, pers. comm.

4.3.5.3 Condition of infrastructure[177]

Climate sensitivity

The destruction of the GPP and associated infrastructure by the Israeli military in 2006 and 2014 leaves its electricity generation sensitive to climate, as there are no fuel pipelines and fuel tankers are affected by weather and road conditions. As noted with regard to domestic energy production, the electricity grids are weak and any changes in the climate that increase the load on the grids could cause interruption in the electricity supply.

Adaptive capacity

There is a need to: connect the GPP with fuel pipelines to reduce use of fuel tankers; rehabilitate existing electricity distribution systems; develop fuel-storage facilities; and import equipment and spare parts required to construct and maintain the infrastructure. However, all are subject to Israeli approval and are usually prevented or delayed.

4.3.6 Food (West Bank) – "Highly vulnerable issues"

4.3.6.1 Domestic food prices[178,179,180,181,182,183]

Climate sensitivity

As explained in relation to the agricultural sector, domestic food production is sensitive to climate. This can lead to food shortages and price instability. The Consumer Price Index (CPI) increased by 1.67% between April 2014 and April 2015, which was attributed to the increase in prices of fresh fruits, vegetables, and poultry. Fresh food prices in Palestinian markets broke historic records in 2013, making nutritious foods unaffordable for low-income households. Increases in prices of fresh vegetables, poultry, and dairy production were attributed mainly to adverse weather conditions (frost and heat waves).

Adaptive capacity

The climate sensitivity of domestic food prices is compounded by limited adaptive capacity. There is a lack of large-scale cold-storage facilities and restrictions on trade in food between West Bank and the Gaza Strip.

4.3.6.2 Imported food prices[184,185,186,187]

Climate sensitivity

Global food prices increased by 8% from December 2011 to March 2012 due to higher oil prices, adverse weather conditions (e.g. Russia banned wheat and grain exports after a heatwave), and Asia's strong demand for food imports. When global food prices rise, local prices also rise. The West Bank imports a significant amount of food for domestic consumption, for example, in 2010, live animals and animal products worth USD171 million and vegetable products worth USD273 million.

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[177] OCHA (2014), The Humanitarian Impact of Gaza's Electricity And Fuel Crisis, United Nations, Office For The Coordination Of Humanitarian Affairs, Occupied Palestinian Territory.
https://www.ochaopt.org/documents/ocha_opt_electricity_factsheet_march_2014_english.pdf
[178] Palestinian News & Info Agency (2015) Consumer Price Index up in April 2015. http://english.wafa.ps/index.php?action=detail&id=28494
[179] Palestinian Central Bureau of Statistics (2007) The Household Expenditure and Consumption Survey (PECS), 2007.
[180] MAS. (2012) Food Security Bulletin. Biannual Bulletin Published by Palestine Economic Policy Research Institute (MAS): Issue 7, Summer 2012. http://www.mas.ps/files/server/20141911181819-1.pdf
[181] Baert, R.; Skoczylas, P.; and Grove, N. (2013) Food Security Watch, West Bank and Gaza Strip, State of Palestine. Issued by UN, WFP, and FAO. October 2013. www.lacs.ps/documentsShow.aspx?ATT_ID=7839
[182] World Bank. (2013) Area C and the future of the Palestinian economy. Poverty Reduction and Economic Management, Department Middle East and North Africa Region, Report No. AUS2922.
https://openknowledge.worldbank.org/bitstream/handle/10986/16686/AUS29220REPLAC0EVISION0January02014.pdf?sequence=1
[183] EQA. (2010) The impact of annexation and expansion wall on the Palestinian environment. Environment Quality Authority, Palestinian National Authority. http://www.lacs.ps/documentsShow.aspx?ATT_ID=6057
[184] World Bank. (2012) Food prices rise again on higher oil prices and adverse weather. News Release No: 2012/411/PREM.
http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/ORGANIZATION/BODEXT/EXTEDS03/0,,contentMDK:23180612~menuPK:380567~pagePK:64099144~piPK:64099061~theSitePK:380554,00.html
[185] PCBS. (2010) Registered Foreign Trade Statistics Goods and Services, Palestinian Central Bureau of Statistics.
http://www.pcbs.gov.ps/Downloads/book1817.pdf
[186] Vidal, J. (2013) Climate change: how a warming world is a threat to our food supplies. The impact of climate on food.
http://www.theguardian.com/environment/2013/apr/13/climate-change-threat-food-supplies
[187] B'Tselem. (2015) The Tightened siege and intensified economic sanctions, B'Tselem - The Israeli Information Center for Human Rights in the Occupied Territories.
http://www.btselem.org/gaza_strip/siege_tightening

Adaptive capacity

Due to the financial crisis, the State of Palestine is not able to construct large-scale storage facilities and grain silos to import and store food and grain when prices are low during periods of low demand in the international markets. Logistical problems drive up food prices, as there is no airport, which means low-income households cannot afford to purchase imported foods. Most food is imported through Israel, increasing costs and, therefore, prices. Israel refuses to allow use of abandoned Qalandia Airport for importing food. Israeli occupation delays issuing of import licences. Barriers to imports increase the cost of trade and, thus, food prices.

4.3.7 Food (Gaza Strip) – "Highly vulnerable issues"

4.3.7.1 Domestic food prices[188,189,190,191]

Climate sensitivity

The sensitivity of domestic food prices in relation to climate is the same as in the West Bank. The Consumer Price Index (CPI) increased by 4.18% between April 2014 and April 2015 and was also attributed to the increase in prices of fresh fruits, vegetables, and poultry.

Adaptive capacity

Issues limiting adaptive capacity to contend with the climate sensitivity of domestic food prices are similar but even more profound in the Gaza Strip than in the West Bank. Not only there is similar lack of large-scale cold-storage facilities but, furthermore, many food-processing facilities have been destroyed by Israeli air strikes during the last three wars (2008, 2012, and 2014). People are also more financially insecure and less able to cope with price volatility.

4.3.7.2 Imported food prices[192,193,194,195]

Climate sensitivity

Imported food prices are sensitive to climate for the same reasons as in the West Bank

Adaptive capacity

Adaptive capacity is limited in the similar ways to the West Bank. Israel destroyed the Gaza Strip's airport prevents construction of the seaport and does not usually allow import of food. Hence, stocks of imported food products in the Gaza Strip are dwindling, driving their prices sky-high.

4.3.8 Gender (West Bank) – "Highly vulnerable" issues

4.3.8.1 Major diseases related to water and sanitation[196]

Climate sensitivity

In general, women lack access to resources and opportunities for improving and diversifying their livelihoods. They are the primary care-givers in rural families. Drought or flooding, as well as long-term incremental changes in rainfall patterns and temperatures that also lead to changes in ecosystems, have important gender-differentiated impacts on all aspects of human livelihoods, activities and health.

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[188] Wafa News Agency. (2015) Consumer Price Index up in April 2015. Palestinian News & Info Agency http://english.wafa.ps/index.php?action=detail&id=284 94

[189] PECS (2007) The Household Expenditure and Consumption Survey, Stat of Palestine, Palestinian Central Bureau of Statistics, 2007. http://www.pcbs.gov.ps/PCBS-Metadata-en-v4.2/index.php/catalog/33

[190] MAS. (2012) Food Security Bulletin. Biannual Bulletin Published by Palestine Economic Policy Research Institute (MAS): Issue 7. http://www.mas.ps/files/server/20141911181819-1.pdf

[191] Baert, R.; Skoczylas, P.; and Grove, N. (2013) Food Security Watch, West Bank and Gaza Strip, State of Palestine. Issued by UN, WFP, and FAO. October 2013. www.lacs.ps/documentsShow.aspx?ATT_ID=7839

[192] World Bank. (2012) Food prices rise again on higher oil prices and adverse weather. News Release No: 2012/411/PREM. http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/ORGANIZATION/BODEXT/EXTEDS03/0,,contentMDK:23180612~menuPK:380567~pagePK:64099144~piPK:64099061~theSitePK:380554,00.html

[193] PCBS. (2010) Registered Foreign Trade Statistics Goods and Services, Palestinian Central Bureau of Statistics. http://www.pcbs.gov.ps/Downloads/book1817.pdf

[194] Vidal, J. (2013) Climate change: how a warming world is a threat to our food supplies – The impact of climate on food. http://www.theguardian.com/environment/2013/apr/13/climate-change-threat-food-supplies

[195] B'Tselem. (2015) The tightened siege and intensified economic sanctions, B'Tselem - The Israeli Information Center for Human Rights in the Occupied Territories. http://www.btselem.org/gaza_strip/siege_tightening

[196] Palestinian Women Research and Documentation Center (2010) Women's health surveillance report: towards a multi-dimensional look at the health of Palestinian women. UNESCO, Palestine.

Due to a lack of safe drinking water and sanitation services, the health of women and children, in particular, is being adversely affected. Water shortages and sanitation problems cause particularly acute problems for women, increasing domestic work burdens and the incidence of water-borne diseases among family members.

Adaptive capacity

The State of Palestine has launched many projects from a gender perspective, with help from international donors, to decrease major diseases related to water and sanitation. However, major issues limiting adaptive capacity are: increasing poverty and unemployment rates; lack of alternative plans for emergency situations, including financial shortages; and insufficient resources to develop the water and sanitation infrastructure, and to expand community-based behaviour-centered programmes that promote improved hygiene practices at the community and household level. Restrictions on movement imposed by Israel continue to impede access to health care, more particularly for women and children in Area C.

4.3.9 Gender (Gaza Strip) – "Highly vulnerable" issues

4.3.9.1 Employment and gender[197,198]

Climate sensitivity

As noted for the West Bank (above), climate variability has important gender-differentiated impacts on all aspects of human livelihoods. In this context, employment is a significant issue in the Gaza Strip, where only 14.9% of women are employed, as compared with 65.9% of men. Women's access to the labour market is difficult and salary inequality is a major issue. Refugee women are more affected by unemployment than non-refugee women, as the latter work in agriculture and, so, have greater employment opportunities. The political situation together with local traditions are the main factors affecting women's livelihood choices and their economic independence. The main sectors of women's employment are agriculture, services, and the informal (non-governmental) sector. Women face difficulties in marketing handicrafts and food-processed products. Women`s roles in agriculture and environmental projects are unique in the Gaza Strip, as the occupation forces women to perform a variety of male tasks. Women's work (e.g. in the agricultural sector) is often invisible and unrecognized, so their innovative practices are not given due attention. Women are major contributors to water management, while at the same time suffering disproportionately from the impacts of water shortages or changes in agriculture. Men benefit from a majority of agricultural projects, especially training and extension services, although women perform most of the work. Unfortunately, there is a lack of disaggregated and verifiable data on gender in relation to water and agriculture.

Adaptive capacity

The Palestinian Government, with help from international donors, has launched many important projects to increase the rate of women's employment. However, the following major issues limit adaptive capacity in this regard: the continuing presence of patriarchal social roles; long-standing legislative uncertainty; Palestinian institutions' lack of formal gender policies; discrimination against women and workers with family responsibilities; continuing perceptions that employing women threatens men's work opportunities, and is more expensive for the employer because of the potential need to provide maternity leave; and insufficient women in management and, particularly, senior management positions. As a result donor-led gender units may not be sustainable. More specifically, there is lack of conceptual understanding of relations between gender issues and integrated water resources management.

4.3.9.2 Major diseases related to water and sanitation[199]

Climate sensitivity

Major diseases related to water and sanitation are a climate-sensitive gender-related issue in the Gaza Strip for the same reasons identified for the West Bank.

[197] Water and Solid Waste Management Programmes (2011) Situation analysis for women in the water and solid waste management sectors. GIZ, Palestine.
[198] UNICEF (2011) Occupied Palestinian Territory – MENA Gender Equality Profile: status of girls and women in the Middle East and North Africa.
[199] Palestinian Women Research and Documentation Center (2010) Women's health surveillance report: towards a multi-dimensional look at the health of Palestinian women. UNESCO, Palestine.

Adaptive capacity

Important issues which limiting adaptive capacity are also the same as in the West Bank.

4.3.9.3 Food security and gender[200,201]

Climate sensitivity

The level of food insecurity among female-headed households is 17% higher than among male-headed households.

Adaptive capacity

Adaptive capacity is defined by the same issues identified in relation to employment and gender.

4.3.10 Health (West Bank) – "Highly vulnerable" issues

4.3.10.1 Major diseases related to water, sanitation and food[202,203]

Climate sensitivity

Changes in temperature, humidity and rainfall directly influence the likelihood of water-borne, food-borne, and vector-borne disease transmission as well as disease. However, the impact of climate on water and food supplies also indirectly affects the likelihood of such diseases.

Inadequate water supplies, either in quantity or quality, may increase risk of waterborne illnesses, such as diarrhoea, typhoid, hepatitis, dysentery, giardiasis, bilharzia, and cholera. Communicable diseases, such as hepatitis, are the most prevalent and most serious. Although epidemiological data in the West Bank is patchy, anecdotal evidence suggests that there is a high-incidence of water-borne diseases leading to substantial costs and losses. In a Palestinian Hydrology Group (PHG) survey, more than 20% of all communities reported that at least 1% of the population had water-related health problems. Diarrheal diseases are significant causes of morbidity in infants and children in the State of Palestine. 44% of children from herder and Bedouin communities in Area C suffer from diarrhoea. Lack of water and highly saline water can also result in kidney dysfunction or failure; a situation exacerbated by hot weather. Reduced dilution of contaminants in water ingested can have long-term consequences for health, e.g. nitrate concentrations can increase anaemia and induce spontaneous abortion.

Floods can disrupt basic sanitation systems, promoting disease outbreaks via the faecal-oral route and the likelihood of vector-borne diseases through expansion of the number and range of vector habitats.

The climate sensitivity of domestic food production can lead to food shortages and resultant malnutrition amongst low-income households. Mounting pressure on freshwater resources is leading to increased use of wastewater for irrigation in the West Bank, which if improperly treated can present health risks to farmers and consumers.

Weather conditions, including temperature, humidity, and wind, affect the impact of anthropogenic sources of pollutants on ambient air quality and increase ambient concentrations of allergens and suspended particulate matter (including pollen and dust), and ground-level ozone, all of which can exacerbate respiratory illnesses.

Extreme weather events can also lead to a range of psychological impacts due to loss, social disruption, displacement, and repeated exposure to natural disasters.

Adaptive capacity

The State of Palestine is aware of the level of health problems, and has developed national strategies and implemented many important projects. However, the following factors limit adaptive capacity:

- Insufficient resources to develop adequate water and sanitation infrastructure, and to expand community-based behaviour-centred programmes that promote improved hygiene practices at the community and household level
- A shortage of specialized health workers and emigration of qualified personnel

[200] Water and solid waste management programmes (2011) Situation analysis for women in the water and solid waste management sectors. GIZ, Palestine.
[201] UNICEF (2011) Occupied Palestinian Territory – MENA Gender Equality Profile: status of girls and women in the Middle East and North Africa.
[202] Palestinian Hydrology Group (2003) Water and Sanitation Hygiene Monitoring Project. Ramallah, Palestine.
[203] Ministry of Health (2013) National Health Strategy, 2014-2016. Ramallah, Palestine.

- Increasing poverty and unemployment rates
- Lack of alternative plans and funding for emergency situations
- Israel's occupation, blockade and restrictions on movement and access restrictions, which impede effective action on inter-related crises, e.g. in relation to water supplies or food production
- Disposal of Israeli waste and food waste from Israeli settlements' food industries, including hazardous waste (most unidentified and from unknown sources), in the State of Palestine.

4.3.11 Health (Gaza Strip) – "Highly vulnerable" issues

4.3.11.1 Major diseases related to water, sanitation and food[204]

Climate sensitivity

General issues concerning the climate sensitivity of major diseases in relation to water, sanitation and food identified in relation to the West Bank also apply to the Gaza Strip.

The Coastal Aquifer is the Gaza Strip's sole source of freshwater and is currently facing a serious challenge in terms of quantity and quality. Only 3.8% of domestic water meets World Health Organization (WHO) standards. Between 90% and 95% of drinking water is contaminated by sewage, and there is increasing incidence of water-borne diseases, particularly hepatitis, meningitis, and typhoid. Contamination of water by microbes (including faecal coliforms and faecal streptococcus) increases at each point the process of water supply. Inadequate water for hygiene purposes is also known to be a significant cause of diarrhoea in children under five. Intestinal parasites, both helminths (worms) and protozoa, infect children throughout the Gaza Strip. The level of infestation is still high in some locations, particularly in agricultural communities and near sewage-treatment ponds, despite implementation of control measures many decades ago. Other sanitary-related diseases, such as skin diseases, are increasing, especially in areas with inadequate water supply. Water-related diseases account for approximately 26% of disease in the Gaza Strip and are the primary cause of child morbidity. In 2009, diarrhoea was the cause of 12% of infant and young child deaths in the Gaza strip, despite being preventable and easily treated.

A range of chemicals are found in drinking water at concentrations that far exceed WHO and Palestinian Water Authority Guidelines. Nitrate and chloride levels are as much as six times the levels set by WHO. Elevated nitrate levels risk poisoning infants under six months old. High concentrations of fluoride are also toxic and may result in gastroenteritis, acute kidney poisoning, and various degrees of liver and heart damage.

Adaptive capacity

The Palestinian government is aware of the extent of health problems, and has developed national strategies and implemented many important projects, however, the following factors continue to limit adaptive capacity:

- The need to strengthen policies, strategies, responses, coordination, sustained community-based programming, and donor support in relation to water, sanitation and nutrition, as well as maladapted behaviour inevitably result in increasing child mortality, morbidity and impaired intellectual development inevitable.
- High levels of poverty in the Gaza Strip result in households making use of unsafe water supplies.
- The need for long-term funding to help prevent or reverse a decline in children's health linked with unsafe water, a contaminated environment, and deteriorating community health services and hospitals.
- Hygiene practices in the Gaza Strip are not adapted to chronic conditions of unsafe and inadequate water, poor sanitation and a contaminated environment.
- Worming treatments administered to school children do not reach young children who are most vulnerable to being affected by parasites
- Major investments need to target long-term infrastructure rather than small emergency projects

[204] UNICEF (2011) Protecting Children from Water Unsafe in Gaza Strategy, Action Plan and Project Resources. Gaza, Palestine.

- To an even greater extent than in the West Bank, Israel's occupation, blockade and restrictions on movement and access restrictions impede effective action on inter-related crises, e.g. in relation to water supplies or food production.

4.3.12 Industry (West Bank) – "Highly vulnerable" issues

4.3.12.1 Value of raw materials imported

Climate sensitivity

The amount and, therefore, value of raw materials imported by a wide range of industries is potentially sensitive to changes in climate. For example, more raw materials may be imported for:

- Producing medicine to treat illnesses resulting from extreme climate conditions
- Manufacturing beverages and drinks in hot weather
- Producing sweets (e.g. flour and sugar) during cold weather
- Producing building insulation in response to extreme climate changes.

Adaptive capacity

There is a need to encourage and support direct import of materials by Palestinian companies, whenever possible, to reduce import costs. Reducing customs and taxes on imported materials for industry could be a possibility. Establishment of an investment promotion body could encourage new industries that could make greater use of locally-available raw materials. It would be beneficial to import materials directly rather than through Israeli agents and to establish a Palestinian certifying body and laboratories to avoid need to secure certifications and approval from the Israeli Institute of Standards. It would also be securing importation of a larger share of raw materials from countries other than Israel (e.g. China, Turkey, EU, and USA).

4.3.12.2 Infrastructure[205]

Climate sensitivity

Storms can damage factories and lead to their collapse. There are irregularities in water supplies needed for manufacturing, which may be exacerbated by the sensitivity of the condition of the water infrastructure to climate, described below. The wastewater collection system is weak in most locations in Palestine and industrial wastewater is not separated from domestic wastewater. The situation would be exacerbated by increased rainfall and could lead to industrial production being interrupted due to water being cut-off or unavailable or to industrial workers suffering health problems. The climate sensitivity of infrastructure associated with domestic energy production and energy imports, described above, may mean that required fuel and electricity may be unavailable or infrastructure not adequate. Factories may not provide a suitable working environment in factories during extremely hot or cold weather (e.g. due to lack of adequate air-conditioning or heating).

Adaptive capacity

Industrial Free Zones and promising laws encourage investors to establish new enterprises. Work progresses to provide energy infrastructure, such as high-voltage electricity, and LPG supply for industry. Internet access and computers, as well as other advanced technologies, are available in the State of Palestine. However, Israeli permits are required for West Bank factories and there are Israeli restrictions on: developing new industries; constructing and rehabilitating roads between cities; import of new equipment and machinery, especially high technology; and internet access and wireless communication systems.

4.3.12.3 Energy supply

Climate sensitivity

The condition of the electricity grid makes it vulnerable to interruption as a result of overloading (a situation made worse by electricity losses from the grid) and extreme weather conditions. Lack of fuel pipelines and fuel-storage facilities means that fuel supplies required by industry need to be transported

[205] Union of Stone and Marble Industry (2011) Stone and marble in Palestine: developing a strategy for the future. http://blair.3cdn.net/328bd530dca6a02f4c_kum6b6dhi.pdf

by tanker and are, thus, sensitive to extreme weather conditions compounded by the condition of the roads.

Adaptive capacity

There is a need to provide a reliable electricity supply by rehabilitating the electricity grid and establishing a national high-voltage transmission line. The electricity grid is being connected with Jordan in the Jericho region, so that electricity can be imported from Jordan, two new power stations are proposed and a range of measures are being taken to promote production of renewable energy. However, Israeli restrictions hamper progress with many issues relating to improving energy supply for industry, including: establishment of national storage facilities for fuel and LPG in order to avoid interruptions in supply; exploration of the possible discovery of natural gas in the West Bank; import of fuel through Jordan as well as Israel; use of natural gas from the Gaza Strip rather than from Israel; and long-term agreements or contracts with Israeli electricity and fuel companies to supply the West Bank.

4.3.12.4 Energy demand

Climate sensitivity

Industrial demand for electricity and fuel exceeds supply during extreme cold or hot weather, as it is required for heating and/or cooling (e.g. as result of frosts or heatwaves). Hence, in general, longer winters or longer summers would increase energy demands. However, industrial production is sensitive to climate in ways that can lead to an increase in energy demand. For example, less heavy rainfall or snow can lead to: fewer interruptions in the electricity supply; fewer delays to delivery of raw materials; and fewer interruptions in operation of machinery, such as stone crushers at quarries.

Adaptive capacity

The Palestinian Government needs to establish electricity tariffs that better manage demand and consumption. Energy demand needs to be reduced by further encouraging energy efficiency measures in industrial production, including through introduction of modern production technologies.

4.3.13 Industry (Gaza Strip) – "Highly vulnerable" issues[206,207,208]

4.3.13.1 Value of industrial products exported

Climate sensitivity

Many industries are highly dependent on the Israeli market. Closure of the border and seaport make it difficult to import raw materials and export products. The length of time that products destined for export can be kept waiting at the border inevitably means that many are sensitive to climate, which affects their quality and, therefore, value.

Adaptive capacity

Lack of suitable storage facilities means that those products that are likely to be most negatively affected by climate include food (particularly frozen and refrigerated products), textiles, furniture, cosmetics, and cleaning products.

4.3.13.2 Value of raw materials exported

Climate sensitivity

Issues in relation to the value of industrial products exported also apply to the value of raw materials exported.

Adaptive capacity

The situation is compounded by inadequate handling, fumigation, packaging and storage techniques.

[206] Palestinian Federation of Industries
http://www.wafainfo.ps/atemplate.aspx?id=3107
[207] Hanieh, A. A., AbdElall, S. and Hasan, A. (2013). "Sustainable Development of Stone and Marble Sector in Palestine." Journal of Cleaner Production, Volume 84, Pages 581-588
[208] GISHA (2010), Partial List of Items Prohibited/Permitted into the Gaza Strip, May 2010
http://gisha.org/UserFiles/File/HiddenMessages/ItemsGazaStrip060510.pdf

4.3.13.3 Employment

Climate sensitivity

More than 120,000 people are employed by industry in the Gaza Strip, around 20% of the total workforce. Approximately 90% of all industrial enterprises have fewer than 10 employees. However, a few mining and construction companies have more than 100 employees. Industrial supply chains are sensitive to climate in a range of ways that have consequences for employment.

Adaptive capacity

Actions by Israel have led to stagnation of the Palestinian economy. The list of raw materials and industrial products prohibited by Israel for import and export severely affects many production processes and several industries in the Gaza Strip are no longer viable.

4.3.13.4 Energy supply

Climate sensitivity

Energy consumption by industry is around 1,438TJ, which accounts for around 6.5% of the total energy consumed in the Gaza Strip, and is liable to increase in response to increasing temperatures and heatwaves due to the need for more air-conditioning and cold storage. This would not only have implications for the security of the electricity supply but also for industries' competitiveness

Adaptive capacity

In order to avoid having to reschedule production according to when electricity is available, some industries make use of private electricity generators but this has to be balanced with the potential for any associated increase in production costs to reduce their competitiveness.

4.3.13.5 Energy demand

Climate sensitivity

Industrial demand for energy is sensitive to climate, as described in relation to energy supply above.

Adaptive capacity

Any increase in energy demand will be compounded by the outdated energy inefficient equipment used by many industries. Hence, it would be beneficial to conduct energy audits in order to increase industries' use of energy efficiency measures and rehabilitate and maintain industrial equipment. Reducing energy consumption through introducing modern production technologies is not a viable option due to Israeli restrictions on imports into the Gaza Strip.

4.3.14 Terrestrial ecosystems (West Bank) – "Highly vulnerable" issues

4.3.14.1 Habitat connectivity[209,210,211]

Climate sensitivity

The State of Palestine's strategic position at the meeting point between Eurasia and Africa enriches the country's biodiversity. Species will need to shift their ranges in response to changes in climate. However, the extreme climatic conditions and human activities limit species' abilities to move between terrestrial ecosystems.

Adaptive capacity

There is insufficient environmental awareness in the West Bank and application of land-use policies is inadequate. The Annexation and Expansion Wall and associated fencing and removal of vegetation has degraded the natural habitat, reduced habitat connectivity and limits species movement. This has had a significant impact on gazelle, ibex, fox, porcupine and badger, which have large home ranges, resulting in inbreeding. Pressures on wildlife, loss of habitat and a reduction in habitat connectivity have

[209] ARIJ. (1997) The status of the environment in the West Bank, Applied Research Institute. Jerusalem. http://www.arij.org/files/admin/1997-3_The_Status_of_the_Environment_in_the_West_Bank.pdf
[210] Al Qutob, M.A. (2014) Floral diversity in Palestine. http://www.fatehmofr.ps/book-of-the-month-the-fauna-and-flora-of-palestine
[211] EQA. (2010) The impact of Annexation and Expansion Wall on the Palestinian environment. Environment Quality Authority, Palestinian National Authority. http://www.lacs.ps/documentsShow.aspx?ATT_ID=6057

also resulted from confiscation of land for the Israeli Illegal Settlements Regime, bypass roads and Israeli Occupation military areas.

4.3.15 Terrestrial ecosystems (Gaza Strip) – "Highly vulnerable" issues

4.3.15.1 Wadi Gaza – Habitat connectivity[212,213,214]

Climate sensitivity

Wadi Gaza Nature Reserve is home to at least 154 terrestrial vertebrate species, most notably birds. It also supports a diverse flora with 70 species (32 families and 24 orders) recorded, including some crop wild-relatives, such as barley (*Hordeum sp.*), parsley (*Petroselinum sativum*), common sage (*Salvia sp.*), peppermint (*Mentha sp.*) and sweet basil (*Ocimum sp.*). As elsewhere, species will need to shift their ranges in response to changes in climate.

Adaptive capacity

Ongoing loss of habitat is increasing habitat fragmentation and reducing habitat connectivity, as a result of: creeping urban development; alteration and destruction of habitats; environmental pollution; intensive use of herbicides and pesticides; and human disturbance. Israel has destroyed the Gaza Valley, which is the main natural feature of the Gaza Strip, by inundating it with untreated wastewater.

4.3.16 Tourism (West Bank) – "Highly vulnerable" issues

4.3.16.1 Condition of cultural heritage[215,216,217]

Climate sensitivity

The State of Palestine is known worldwide as the "Holy Land", as it is the focus of three major monotheistic religions It embraces a large number of historical, cultural, and religious sites, which are potentially major tourist attractions. The condition of these sites is sensitive to climate extremes.

Adaptive capacity

The State of Palestine has launched a few projects to maintain and improve the condition of the cultural heritage with help from international donors, however, major needs to enhance adaptive capacity are:

- Stronger regulations to prevent construction of new buildings in very sensitive areas (e.g. along wadis), which potentially increases the sensitivity of the local cultural heritage, e.g. in relation to flooding
- Better enforcement of legislation to avoid cultural heritage sites being left open to assault
- Greater maintenance of cultural heritage sites
- More coordination between relevant institutions
- Stronger national registration and classification of cultural heritage sites
- Enhanced city and regional plans and related by-laws, including conservation guidelines
- Increased awareness of the importance of conserving and restoring cultural heritage sites.

Israeli measures in the State of Palestine explicitly target religious and cultural heritage sites, and have led to damage and demolition of mosques and ancient sites. Constant military incursions and unilateral actions taken by Israel in the State of Palestine threaten development of, or investment in, conservation measures.

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[212] Rabou, A.F.N.A.; Yassin, M.M.; Al-Agha, M.R.; Hamad, D.M. and Ali, A.K.S. (2007) The avifauna of Wadi Gaza Nature Reserve, Gaza Strip, Palestine. The Islamic University Journal (Series of Natural Studies and Engineering) 15:1, 39-85. http// www.iugaza.edu.ps/ara/research

[213] Rabou, A.F.N.A.; Yassin, M.M.; Al- Agha, M.R.; Madi, M.I.; Al-Wali, M.M.; Ali, A.K.S. and Hamad, D.M. (2008) Notes on some common flora and its uses in Wadi Gaza, Gaza Strip. The Islamic University Journal (Series of Natural Studies and Engineering), 16:1, 31-63. http://www.iugaza.edu.ps/ara/research//

[214] Jalal, R.A. (2013) Gaza Valley Faces Environmental Disaster. Al-monitor. http://www.al-monitor.com/pulse/originals/2013/08/wadi-gaza-valley-environment-sewage.html

[215] International Chamber of Commerce (2013) Palestine tourism sector. Ramallah, Palestine.

[216] Palestinian Central Bureau of Statistics (2011) Tourism activities report, 2010: main results. Ramallah, Palestine.

[217] World Tourism Organization (UNWTO), the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) (2008) Climate Change and Tourism Responding to Global Challenges.

4.3.17 Urban and infrastructure (West Bank) – "Highly vulnerable" issues

4.3.17.1 Urbanization[218]

Climate sensitivity

Urban areas are sensitive to floods, heat waves, droughts, and other extreme events. Rapid population growth and urbanization are contributing to the sensitivity of cities to climate. The average population density is 468 people per km², which is higher than neighbouring countries. In 2007, 73.7% of the total population lived in urban areas, with 17% living in rural areas and the remainder, c.10%, resident in refugee camps. Rapid urbanization is occurring because of high fertility rates, substantial rural-urban immigration, and the concentration of economic activity in urban areas. The road infrastructure is in a poor condition and heavy rainfall can lead to their erosion, collapse and closure, and to accidents due to the presence of dangerous curves and slopes coupled with a lack of retaining walls, traffic signals and pedestrian bridges.

Adaptive capacity

The State of Palestine has launched a vital project to enhance urban planning but major needs to enhance adaptive capacity include:

- Better policies and administration in relation to urban planning
- Management of the growth of cities, so that they are able to provide basic services and infrastructure to their existing populations
- Regional planning and connectivity between population centres to be within the State of Palestine's control and not subject to physical disruption from Israeli settlement activities
- Open spaces between rural and urban communities in the State of Palestine to be within the Palestinian Government's control
- Lifting Israeli of restrictions on movement, development and growth of major urban centres; rural communities maintain much of their rural character but have been "urbanized".

4.3.18 Urban and infrastructure (Gaza Strip) – "Highly vulnerable" issues

4.3.18.1 Building conditions[219,220,221]

Climate sensitivity

Recent developments have used imported western styles of architecture and techniques that are ill-suited to Palestinian climatic conditions. New urban centers include modern high-rise buildings with glass facades; the antithesis of thermal massing. These towers feature inoperable windows and create a huge energy demand to power air conditioning systems. As described for the West Bank, roads are in poor condition.

Adaptive capacity

Green buildings reduce climate sensitivity and provide many benefits, including: increased return on investment; reduced energy, operating, and maintenance costs; better occupant health and productivity; and reduced use of natural resources. However currently, there are only a few green buildings in the Gaza Strip. The State of Palestine has developed guidelines for green buildings and there are many Palestinian institutions that are promoting their construction.

4.3.19 Waste and wastewater (West Bank) – "Highly vulnerable" issues

4.3.19.1 Waste management[222]

Climate sensitivity

Waste management operations are sensitive to temperatures, rainfall patterns, wind speeds, and storms. Temperature affects the biological activities within treatment systems, while storms affect the leaching process within solid treatment plants. In 2009, about 1,710 tons/day of residential solid waste

[218] UN-Habitat (2014) National Report. Ramallah, Palestine.
[219] UN-Habitat (2014) National Report. Ramallah, Palestine.
[220] Engineering Association (2013) Green Buildings Guidelines. Ramallah, Palestine.
[221] Palestinian Central Bureau of Statistics (2011) Housing Conditions Survey 2010. Ramallah, Palestine.
[222] Palestinian National Authority (2010) National Strategy for Solid Waste Management in the Palestinian Territory (2010-2014).

was generated. The average daily residential solid waste generated per dwelling is 3.9 kg/day at an average rate of 0.7 kg/capita/day. In 2009, healthcare centres generated an estimated 472 tons/month of solid waste, while industrial establishments generated an estimated 6,308 tons/month. About 95% of the West Bank is served by solid collection and transport services. Efforts to promote recycling and reuse of solid waste are largely limited to initiatives by individuals or the voluntary sector. There are unsafe approaches to dealing with solid waste, including use of random dumpsites, open waste burning, and partial mismanagement of medical and hazardous waste. Solid waste collection and transport operations are moderately efficient.

Adaptive capacity

The State of Palestine has constructed a number of regional sanitary landfills (Zahrat Al-Funjan landfill, Jericho landfill and AL-Minya), which help to reduce risks to health and the environment caused by random dumpsites, which are commonly spread throughout the districts. The State of Palestine is aware of the extent of the solid waste problem, and has passed new laws and developed national strategies to address it. However, major needs to enhance adaptive capacity are:

- More attention to be paid to relevant social, economic, environmental, technical, and legislative issues
- Enhanced legal, organizational, and institutional frameworks in order to address handling of hazardous waste
- Greater experience in minimizing or recycling greenhouse-gas emissions from landfill sites, which could gain credits from carbon trading mechanisms
- Comprehensive systems for authentication and analysis of data and monitoring and evaluation
- Increased participation of the private sector in solid waste management.
- Discontinuation of Israel's disposal of waste, including hazardous waste (most of which is unidentified from unknown sources), in the State of Palestine.
- Cessation of Israel's relocation of internationally-forbidden industries to the West Bank and disposal of toxic effluents without treatment in the State of Palestine
- The State of Palestine to have jurisdiction and control over resources (including within Area C)
- Land availability to implement several projects and construction of regional facilities.

4.3.20 Waste and wastewater (Gaza Strip) – "Highly vulnerable" issues

4.3.20.1 Waste management[223,224]

Climate sensitivity

Issues in relation to the climate sensitivity of waste management are the same in the Gaza Strip as described for the West Bank. In 2015, about 716 tons/day of residential solid waste was generated, which comprised approximately 67% organic matter, 11% plastics, and 12% paper with the remainder being metals, glass and other waste materials. The average daily residential solid waste generated per dwelling in 2009 was 2.7 kg/day at an average rate of 0.4 kg/capita/day. In 2009, healthcare centres generated an estimated 730 tons/month of solid waste, while industrial establishments generated an estimated 14,996 tons/month.

Adaptive capacity

The Palestinian government has launched a regional sanitary landfill (Deir-El-Balah), which helps to reduce risks to health and the environment caused by random dumpsites, which are commonly spread throughout the Gaza Strip. Major needs limiting adaptive capacity are very similar to those in the West Bank. In addition, Israel needs to allow entry of materials for construction, repair and rehabilitation of infrastructure that would enable improved waste management.

[223] Palestinian National Authority (2010) National Strategy for Solid Waste Management in the Palestinian Territory (2010-2014).
[224] Palestinian Central Bureau of Statistics (2015) Press Release on Household Environmental Survey, 2015. http://www.pcbs.gov.ps/site/512/default.aspx?tabID=512&lang=en&ItemID=1454&mid=3171&wversion=Staging

4.3.21 Water (West Bank) – "Highly vulnerable" issues

4.3.21.1 Groundwater supply[225],[226],[227],[228]

Climate sensitivity

Water resources in the West Bank are limited. The groundwater aquifer is the major source of freshwater supply and is shared between Palestine and Israel. There is excessive pumping or mining of shared aquifers by Israeli occupation. Reduced rainfall results in lower groundwater recharge, as does high-intensity rainfall due to increased run-off. High temperatures increase demand for water and increase the amount of water discharged from aquifers. Drought conditions lead to ever-decreasing amounts of available groundwater.

Adaptive capacity

The State of Palestine has launched many projects related to use of groundwater, including protection of springs and rehabilitation of wells in different districts. However, the State of Palestine is struggling to attain the most basic level of infrastructure and services of a low-income country. Its agencies are suffering from resource deficiencies and managerial weaknesses. Investment (and investment efficiency) in the West Bank's groundwater supply has dropped to very low levels. The prevailing economic, water resource and institutional constraints mean that the performance of the water utilities is deteriorating. The institutional architecture proposed for the water sector has not been fully implemented. Water harvesting projects are limited and there is an absence of institutional arrangements for shared aquifer systems. There is limited deepening and rehabilitation of wells, protection of springs, and implementation of small-scale desalination units (mostly only as pilot projects).

Since 1967, Israel's policy and practice in the State of Palestine has been to expropriate and assert control over water resources, maintain an unequal and discriminatory allocation of water resources to benefit both Israeli citizens and settlers, and prevent the State of Palestine from developing its resources. The Palestinian Water Authority (PWA) is unable to conduct an integrated water management scheme in the West Bank within the current governance framework. The governance system established by Article 40 of the Oslo Agreement requires the approval by Israeli authorities of any proposed PWA management measure or infrastructure project within the West Bank. This arrangement and its implementation, gives Israeli authorities control over the allocation and management of the West Bank's water resources.

A permit is required from the Israeli Civil Administration within Area C, which covers 61% of the West Bank, for any construction, including water and sanitation projects. . The vast majority of permit applications are denied, and any structure built without a permit may be demolished by the Israeli authorities. Following the 1967 War, Israel took control of the State of Palestine's water resources and developed wells throughout the West Bank together with a water supply network serving settlements that link into the Israel National Water Company (Mekorot) network. The amount of water that Mekorot supplies to the settlements is unofficially estimated at some 75 million m^3, of which 44 million m^3 is produced from wells controlled by Israeli occupation or settlers within the West Bank.

The State of Palestine has access to 20% of the resources of the Mountain Aquifer. Water withdrawals per capita for Palestinians in the West Bank are about 25% of those available to Israelis, and have declined over the last decade. Palestinian abstractions have actually declined over the last ten years, under the combined effect of dropping water tables and restricted drilling to deepen and rehabilitate wells. Over-extraction from deep wells by Israel, combined with reduced groundwater recharge, has created risks for the aquifers and a decline in water available to Palestinians through shallower wells. The construction of the Annexation and Expansion Wall has also resulted in the isolation of several Palestinian groundwater wells and springs previously used for domestic and agricultural purposes.

[225] Amnesty International (2009) Troubled waters: Palestinians denied their fair share of water. London, UK.
[226] Centre on Housing Rights & Evictions (2008) Policies of denial: lack of access to water in the West Bank. Geneva, Switzerland.
[227] PWA (2013) Status report of water resources in the Occupied State of Palestine – 2012. Ramallah, Palestine.
[228] World Bank (2009) Assessment of restrictions on Palestinian water sector development. Middle East and North Africa Region Sustainable Development, Report No. 47657-GZ. Ramallah, Palestine.

4.3.21.2 Flood management[229,230,231]

Climate sensitivity

Urban development increases the amount of water runoff. Storm-water systems in the West Bank are under-designed and poorly managed. Localized flooding occurs in urban areas where there are too few drains, or where their capacity is insufficient to deal with heavy precipitation. Drought allows build-up of solid waste and sediments that can block storm-water drains, impeding the flow of water from the impacted area and polluting a wider area. The overstretched infrastructure is further pressured by increasing urban growth and rural to urban migration.

Adaptive capacity

Palestinians have the necessary technology and skills to match urban-drainage systems to the demands made by heavy precipitation. However, adaptive capacity is limited by the scale of required investments in flood management, and the municipalities' and village councils' lack of resources and managerial weaknesses. The State of Palestine faces the challenge of compulsory connection with Israel's infrastructure. Israel has blocked every possible means by which the Palestinians might manage flooding.

4.3.21.3 Condition of infrastructure[232,233,234]

Climate sensitivity

The condition of urban drainage systems is sensitive to climate for reasons described in relation to flood management. Water losses from open canals, dams and agricultural ponds are considerable due to high evaporation and the presence of cracks and leaks.

Adaptive capacity

Adaptive capacity in relation to the condition of urban drainage systems is as described for flood management. Many of the issues limiting the State of Palestine's adaptive capacity in relation to groundwater supply, described above, are also relevant in relation to the condition of the water infrastructure. Many Palestinian families, especially in rural areas, use cisterns and rainwater harvesting tanks, some of which are centuries old, to gather and store rainwater. Lots of agricultural ponds have been constructed, which are rainwater-fed. Water is conveyed through open channels or pipes. Surface-water harvesting of wadis is still not much developed by the PWA despite significant interest, mainly as a result of Israeli restrictions.

Israeli policy and practice to expropriate and assert control over water resources limits adaptive capacity with regard to the condition of the infrastructure, as does the PWA's inability to conduct integrated water management schemes in the West Bank within the current governance framework. Israel imposes severe restrictions on permits for construction of dam and water harvesting projects.

4.3.22 Water (Gaza Strip) – "Highly vulnerable" issues

Water resources are limited and water demand exceeds the available water supply. The Palestinian government has launched many projects related to water management. However, the State of Palestine is struggling to attain the most basic level of infrastructure and services of a low-income country and its agencies are suffering from resource deficiencies and managerial weaknesses. The Gaza Strip has a well-designed Master Plan for water and sanitation, however, less than 2% of the Gaza Strip's investment plan has been implemented. PWA's operations and water resource management in the Gaza Strip have been affected by political instability. PWA has limited progress in development of seawater desalination facilities, although there is an urgent need.

[229] Centre on Housing Rights & Evictions (2008) Policies of denial: lack of access to water in the West Bank. Geneva, Switzerland.
[230] PWA (2013) Status report of water resources in the Occupied State of Palestine – 2012. Ramallah, Palestine.
[231] World Bank (2009) Assessment of restrictions on Palestinian water sector development. Middle East and North Africa Region Sustainable Development Report No. 47657-GZ. Ramallah, Palestine.
[232] PWA (2013) Status report of water resources in the Occupied State of Palestine – 2012. Ramallah, Palestine.
[233] World Bank (2009) Assessment of restrictions on Palestinian water sector development. Middle East and North Africa Region Sustainable Development Report No. 47657-GZ. Ramallah, Palestine.
[234] Palestinian National Authority (2014) National Development Plan (2014-2016). Ramallah, Palestine.

4.3.22.1 Groundwater supply[235,236,237,238]

Climate sensitivity

Water resources are limited and water demand exceeds the available water supply. The coastal aquifer is the main source of groundwater in the Gaza Strip and is a shared aquifer that also underlies Israel and Egypt. The aquifer provides a sustainable yield in the Gaza Strip of around 55 million m^3/year. More than 1.8 million Palestinians in Gaza consume in excess of 200 million m^3/year from the aquifer, thus, taking approximately four times as much water as the aquifer can sustain.. Over-pumping of groundwater has damaged the Gaza aquifer.

Adaptive capacity

Projects launched by the Palestinian government in relation to the use of groundwater, including securing additional water resources and rehabilitating wells in different districts.

There is an absence of institutional arrangements for managing the shared aquifer systems. The private sector and households are coping through implementing unlicensed wells and small-scale desalination. There are also external risks to the coastal aquifer. Network coverage rates are high but closures and conflict have led to a near collapse in the reliability of the water supply. Israel limits the entry of construction materials for construction, repair and rehabilitation of infrastructure that would allow for improved management of the groundwater supply.

Water supply has become very intermittent and has fallen to crisis levels, largely due to the deteriorating political and security situation, which curtails access to power, fuel and spare parts. Mass desalination of sea water as an alternative, which is under consideration by the Palestinian Government even if it is costly and constrained within the current context, given that there are frequent electricity shortages in the Gaza Strip associated with Israel's blockade.

4.3.22.2 Groundwater quality[239,240,241,242]

Climate sensitivity

The water quality of the coastal aquifer has deteriorated to crisis levels, due to the imbalance between groundwater recharge and pumping. The salinity of the coastal aquifer is a major concern. Saltwater intrusion, which results from over-pumping of the aquifer and inland saline water underlying freshwater in the aquifer rising upward into the freshwater zone, will be exacerbated by sea-level rise. The coastal aquifer has a shallow water table with high permeability making it susceptible to all sources of pollution. The aquifer is unconfined in many places in the Gaza Strip, thus, contaminants readily infiltrate through the surface soil layer. Intensive agricultural practices have increased the levels of nitrates. Most sewage is either returned raw to lagoons, wadis and the sea, or seeps through the soil ultimately reaching the aquifer.

Adaptive capacity

Issues limiting adaptive capacity in relation to groundwater quality are the same as those described for groundwater supply.

4.3.22.3 Flood management[243,244,245,246,247]

Climate sensitivity

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[235] Husseini, H. (2000) Protection of Wadi Gaza: an environmental challenge. http://www.husseini1.com/resources/file/publications/127374358904/Protection%20of%20Wadi%20Gaza,%20An%20Environmental%20Challenge,%202000.pdf
[236] Centre on Housing Rights & Evictions (2008) Policies of denial: lack of access to water in the West Bank. Geneva, Switzerland.
[237] PWA (2013) Status report of water resources in the Occupied State of Palestine – 2012. Ramallah, Palestine.
[238] World Bank (2009) Assessment of restrictions on Palestinian water sector development. Middle East and North Africa Region Sustainable Development Report No. 47657-GZ. Ramallah, Palestine.
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[244] Husseini, H. (2000) Protection of Wadi Gaza: an environmental challenge.
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[246] PWA (2013) Status report of water resources in the Occupied State of Palestine – 2012. Ramallah, Palestine.
[247] World Bank (2009) Assessment of restrictions on Palestinian water sector development. Middle East and North Africa Region Sustainable Development Report No. 47657-GZ. Ramallah, Palestine.

Flood management is climate sensitive in the Gaza Strip for the same reasons as in the West Bank

Adaptive capacity

Adaptive capacity is limited in the same ways as in the West Bank. However, Israel limits import of construction materials for construction, repair and rehabilitation of storm-water systems that would provide improved flood management. Israeli occupation has opened a number of dams near the border of the Gaza Strip, which causes the Gaza Valley to flood in severe winter storms.

4.3.23 'Vulnerable' issues

Notably, a substantial number of issues were also identified as 'vulnerable' as a result of Israeli occupation, which were otherwise often rated only as 'Potentially vulnerable'. These issues are listed in Table 27 but have not been prioritized for further consideration in terms of adaptation.

Table 27: Issues ranked as "vulnerable"

Theme/sector	Vulnerable – West Bank	Vulnerable – Gaza Strip
Agriculture		Watermelon production; Greenhouses; Soil erosion; Cut-flower production
Coastal and marine		Coastal agriculture
Energy	Domestic/local energy and prices	Environmental impacts; Social impacts; Imported energy prices; Cost of domestic feedstocks
Food	Food processing sector; Food storage	Exported food prices; Food storage; Food waste
Gender	Employment and gender; Maternal mortality and life expectancy; Food security and gender	Maternal mortality and life expectancy
Health	Mortality morbidity and life expectancy; Infrastructure; Health costs.	Mortality, morbidity and life expectancy; Infrastructure; Health costs
Industry	Industrial production; Value of industrial products imported and exported; Production of raw materials; Value of raw materials exported; Employment; Waste management	Industrial production; Value of industrial products imported; Production of raw materials; Value of raw materials imported; Infrastructure; Waste management
Terrestrial ecosystems	Biodiversity; Invasive species; Forest shrub lands and grasslands; Nature reserves; Birds, mammals, reptile and amphibians; Habitat area; Habitat quality	Biodiversity; Habitat – birds; Wadi Gaza – fauna; Wadi Gaza – flora
Tourism	Infrastructure of the tourism sector; Income from tourism	
Urban and infrastructure	Urban economy; Urban drainage	Urbanization; Urban economy; Urban air pollution;
Waste/wastewater	Management of wastewater	Cost of waste management; Sewerage; Management of wastewater

Theme/sector	Vulnerable – West Bank	Vulnerable – Gaza Strip
Water	Surface water supply; Water quality (surface and groundwater water); Water prices; Volume of water imported	Surface water supply; Surface water quality; Condition of infrastructure; Volume of water imported

4.4 Future-climate scenarios for the State of Palestine

The three future-climate scenarios for the State of Palestine that have been developed to be representative of all projections considered by the IPCC AR5 are summarised below. Further technical details can be found in the NAP's Appendices 4 and 5.

4.4.1 Scenario 1

The most optimistic scenario, most likely should emissions be controlled according to the IPCC target of a global average temperature increase not exceeding 2°C.

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

4.4.2 Scenario 2

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

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

4.4.3 Scenario 3

The most pessimistic scenario, assuming that emissions continue unabated.

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

4.5 Adaptation measures

The identity and summary ranking of adaptation options in relation to 'highly vulnerable' issues for each theme/sector in the West Bank and the Gaza Strip are provided below together with the total costs of each option and summaries of specific technical and capacity needs. All completed 'Performance Matrices' and 'Appraisal' sheets are available on request from EQA and a summary of the costs of each adaptation option for Years 1-5 and 5-10 can be found at the NAP's Appendix 4.

4.5.1 Agriculture

4.5.1.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Enhance sustainable community-level irrigation schemes and infrastructure	Irrigated vegetables	76	19,400,000
2	Climate-smart agriculture	Production of olives, grapes, stone fruits, rain-fed vegetables and field crops	71	146,000,000
3	Improve water-use efficiency and using alternatives water resources	Irrigation water	66	140,000,000
3	Land-use planning and management - greening, afforestation, and rangeland development	Grazing area and soil erosion	66	600,000,000
5	Agricultural disaster risk reduction and management (DRR/M)	Production of olives, grapes, stone fruits, rain-fed vegetables, field crops and livestock	61	88,000,000
6	Increase the availability of animal feed (including plant and organic residues) at an affordable price	Livestock production	60	16,000,000
6	Improve livestock-production pens	Livestock production	60	15,000,000

Specific technical needs

Technologies are readily available in the West Bank to implement most of the selected adaptation options for the agriculture sector with one notable exception. The basket of measures identified for increasing the availability of animal feed at an affordable price includes the need to build large-scale grain-storage silos in order to enable import during periods when prices on the international markets are low. There are currently no such facilities in the West Bank despite the existing presence of fodder factories.

Specific capacity needs

While farmers are familiar with many of the concepts and techniques associated with many of the selected adaptation options for agriculture in the West Bank, there is a need to reinforce and develop capacities in relation to each of them.

Enhancing sustainable community-level irrigation schemes and infrastructure in relation to irrigated vegetables will need to build upon existing capacities in community-based, water-resource management through the establishment of water-user associations.

Knowledge and skills exist within the MOA, FAO, NGOs, and universities with regard to climate-smart agriculture and the production of olives, grapes, stone fruits, rain-fed vegetables and field crops. Additional expertise is required in soil management, water conservation, and agricultural extension. Capacity to adopt and utilize drought-tolerant varieties effectively in the State of Palestine is limited and needs to be developed. Capacities also need to be developed in intercropping, crop rotation and minimum/zero tillage techniques.

Improving water-use efficiency and using alternatives water resources in irrigation will demand training programs to operate the desalination and wastewater treatment plants and to monitor and assure the quality of effluent. Concentrations of salt in treated wastewater for reuse and its biochemical oxygen demand need to be reduced and health risks need to be totally eliminated. Professional irrigation engineers and sustainable water management experts need to be involved. Farmers' capacities to safely and sustainably irrigate with treated wastewater need to be developed.

The Ministry of Agriculture, ICARDA, PARC, UAWC, Palestinian universities and others all possess some relevant knowledge and skills in relation to managing the grazing area and soil erosion through land-use planning and management (greening, afforestation, and rangeland development). However, additional expertise is required in soil and water conservation, and large-scale land management.

Production of olives, grapes, stone fruits, rain-fed vegetables, field crops and livestock are all 'highly vulnerable' but a functioning agricultural disaster-risk reduction and management (DRR/M) system has not yet been established in the State of Palestine. Institutional capacities are needed to perform climate change-related vulnerability assessments at national and governorate level with a special focus on the most vulnerable communities. There is a need to enhance multi-stakeholder information sharing and coordination of preparedness and emergency response activities (including MOA, Palestinian Civil Defense – PCD), PMD, National Spatial Plan – NSP, PWA, food security sector etc.). There is also a need to develop institutional capacities for agricultural insurance and compensation. A structure is already in place (Palestinian Disaster Risk Reduction and Insurance Fund - PADRRIF) but capacities to operate it need to be developed.

The wide range of measures to increase the availability of animal feed at an affordable price include: establishing feed factories; increasing the agricultural area; concentrating on drought-tolerant species, such as barley; as well as building large-scale grain-storage silos. However, there is a shortage of knowledge and skills. For example, large farms usually purchase dairy-cattle food from Israel.

Many farmers do not have the necessary knowledge and skills to improve livestock-production pens. Hence, when companies install modern pens and hangars, people usually receive operational training.

4.5.1.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Climate-smart agriculture: Management of crop production systems including soil and water resources for better environmental sustainability along with improved economic profitability for farmers	Citrus, Olive production, Vegetable production, Employment	80	40,400,000
2	Improve water-use efficiency and using alternatives water resources	Irrigation water	71	14,270,000
3	Establishment of farmers' support (subsidies,	Cost of agricultural production	62	85,000,000

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
	awareness training programs)			
4	Agricultural disaster risk reduction and management (DRR/M)	Cost of agricultural production	61	44,000,000
5	Improve livestock-production pens	Livestock production	60	15,000,000

Specific technical needs

Technical needs with regard to the selected adaptation options for the agriculture sector in the Gaza Strip relate primarily to addressing potential impacts on the cost of agricultural production. Establishment of an approach for farmers' support, including subsidies, needs to be informed by schemes in other countries but be tailored to the Gaza Strip's unique circumstances. There is a need to set up an Early Warning System (EWS) to monitor drought, flood, plant pests and transboundary animal diseases through a combination of remote sensing and indicators collected on the ground. Data and information management is in place, but improvements are needed to facilitate quick and targeted post-disaster response.

Specific capacity needs

While the knowledge and skills exist in the State of Palestine to develop and implement an approach for farmers' support in relation to the cost of agricultural production, there is a need to build upon and develop capacities in relation to all of the other adaptation options.

Knowledge and skills exist within the MoA, FAO, NGOs, and universities in relation to climate-smart agriculture but additional expertise is required in soil management, water conservation, and agricultural extension. There is also a need for capacity-building to enable adoption and effective utilization of drought and salt-tolerant varieties.

In the same way as in the West Bank, there is a need to develop and reinforce existing capacities in community-based, water-resource management through the establishment of water-user associations, and to improve knowledge and skills in relation to use of alternative water resources through training programs and the involvement of professional irrigation engineers and sustainable water management experts.

Establishment of a functioning agricultural DRR/M system that addresses potential impacts on the cost of agricultural production and improvement of livestock-production pens will both demand the same range of capacity-building activities as described for the West Bank (above).

4.5.2 Coastal and marine

4.5.2.1 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Rain-water harvesting	Coastal agriculture	75	500,000
2	Construction of detached breakwaters	Condition of beaches	66	10,000,000
3	Introduction of new saline-tolerant crops	Coastal agriculture	61	500,000

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
4	Enlargement of the fishing area and improve fishing equipment	Fishing/fisheries	57	90,000,000
5	Provision of beach nourishment, reclamation and beach drift rehabilitation	Condition of beaches	56	10,000,000
5	Provision of laboratories and equipment for data collection and analysis	Condition of beaches	56	2,000,000
7	Fish packaging/preservation industry	Fish catch	20	1,000,000

Specific technical needs

With the exception of the construction of detached breakwaters to maintain the condition of beaches, all other adaptation options identified in relation to the coastal and marine sector have specific technical needs, which may be difficult to fulfil due to Israeli import restrictions. At least some of the necessary equipment and technology for rain-water harvesting to sustain coastal agriculture is available in the Gaza Strip. Introduction of new saline-tolerant crops would require applied research to determine the likely extent of saltwater intrusion and appropriate crops suited to the soil-type but this could be hampered by Israeli import restrictions. There are restrictions on importing basic fishing equipment and fuel for vessels and cold storage, which would be required to sustain fishing and fisheries. The sand needed for beach nourishment, reclamation and beach drift rehabilitation and the technology required to transport it are available in the Gaza Strip, but more advanced technologies are needed to pump sand from the sea bed. There is limited availability of equipment at the universities and some governmental offices relevant to provision of laboratories and equipment for data collection and analysis in order to increase understanding of the vulnerability of beaches and the efficacy of adaptation options. Most notably, establishment of a fish packaging and fish preservation industry could only happen if relevant machinery and equipment could be imported, although, unless the fishing area is increased, the fish catch is unlikely to be sufficient to sustain the industry.

Specific capacity needs

Knowledge and skills exist in the State of Palestine to construct detached breakwaters to maintain the condition of beaches, but to a greater or lesser extent there is a need to reinforce and develop capacities in relation to all of the other adaptation options. Farmers have knowledge and skills associated with small-scale rain-water harvesting on which to build. There is a need to increase awareness of the benefits of introducing new saline-tolerant crops and to provide training in their cultivation, as appropriate. Academic and professional knowledge and skills are limited in relation to use of advanced technologies for beach nourishment, reclamation and beach drift rehabilitation, so some training is required. Training would also be needed in use of more advanced equipment for data collection and analysis intended to increase understanding of the vulnerability of beaches. Finally, if equipment for fish packaging and preservation were to be successfully imported then operational training would be needed to make use of it.

4.5.3 Energy

4.5.3.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Generation of solar electricity for medium-large scale commercial and industrial application	Domestic/local energy production	76	99,548,000
1	Use of renewable energy such as solar to reduce imported energy.	Energy imports	76	106,048,000
3	Implement energy efficiency measures to reduce consumption, mainly for commercial and industrial application	Domestic/local energy production	75	10,500,000
3	Implement energy efficiency measures to reduce consumption and hence imported energy	Energy imports	75	13,500,000
5	Electricity grid upgrading	Condition of infrastructure	65	16,250,000
6	Building fossil-fuel storage facilities	Condition of infrastructure	24	21,200,000

Specific technical needs

Technical needs relate primarily to implementation of energy efficiency measures and to building fossil-fuel storage facilities, as the other adaptation options make use of existing technologies available within the West Bank. Suitable technologies are available for small projects and household applications that reduce energy consumption but technologies for industrial or commercial application would need to be imported. The technology to build small-scale, fossil-fuel storage facilities is available in the State of Palestine but technology associated with large-scale facilities would also need to be imported.

Specific capacity needs

While the knowledge and skills exist in the State of Palestine to upgrade the electricity grid, there is a need to build upon and develop capacities in relation to all of the other adaptation options. Existing knowledge and skills with regard to solar energy relate primarily to small-scale applications. Larger-scale installations (> 1MW) demand development of new knowledge and skills. Existing knowledge and skills in relation to energy efficiency relate to household applications. However, capacity building and training is needed for commercial and industrial applications. Palestinians possess the necessary knowledge and skills to build small-scale, fossil-fuel storage facilities, however, will require training to build larger storage facilities and to manage accidents associated with fuel storage.

4.5.3.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Additional supply of energy from neighbouring countries	Total energy imports	81	10,000,000

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
2	Enhancing the equipment and efficiency of the Gaza Power Plant (GPP)	Total domestic energy production	80	10,000,000
3	Use of renewable energy, such as solar, to reduce imported energy.	Total energy imports	76	50,000,000
4	Implement energy efficiency measures to reduce consumption and hence imported energy	Total domestic energy production	75	6,000,000
5	Electricity grid upgrading	Condition of infrastructure	71	100,000,000

Specific technical needs

All of the selected adaptation options are able to make use of existing technologies available in the Gaza Strip with the exception of implementation of energy efficiency measures, where specific technical needs are the same as for the West Bank.

Specific capacity needs

With the exception of negotiating additional supply of energy from neighbouring countries, there is a need to reinforce and develop capacities in relation to each of the selected adaptation options. Local electricity companies have the knowledge and skills to operate the GPP, but some technical or managerial training could be needed to install and operate the new equipment. Specific capacity needs in relation to solar energy and implementation of energy efficiency measures are the same as for the West Bank. Local electricity companies have the knowledge and skills to upgrade the grid. However, more training would improve their emergency response to interruption of the electricity grid, during extreme weather conditions

4.5.4 Food

4.5.4.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Enhancing agricultural value chain and improving infrastructure for livestock-production	Domestic food prices	66	227,500,000
2	Greenhouse management	Domestic food prices	60	25,000,000
3	Construction of large-scale cold storage	Domestic food prices	55	33,000,000
4	Construct large-scale steel silos for grain to enable import and storage during periods when prices on the international markets are low	Imported food prices	47	4,000,000

Specific technical needs

Suitable technologies are available and accessible for improving infrastructure for livestock production, e.g. large-scale poultry-production pens in the Northern part of the West Bank, and for greenhouse management, e.g. irrigation techniques, precision agriculture, frost management, and shading systems. Construction of large-scale cold storage would be able to draw upon some relevant existing technologies available in the State of Palestine, as there are a few existing private cold-storage facilities. However, there are no up-to-date, large-scale grain silos in the State of Palestine, so suitable technology would need to be imported.

Specific capacity needs

Many of the technologies and techniques in relation to improving infrastructure for livestock production and to greenhouse management are already familiar to large private companies. The same is true of cold storage, although techniques need to be improved, especially if facilities are to be enlarged. Lack of experience of constructing large-scale steel silos for grain, means that associated knowledge and skills either need to be developed or outsourced.

4.5.4.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Enhancing agricultural value chain and improving infrastructure for livestock-production	Domestic food prices	66	121,250,000
2	Greenhouse management	Domestic food prices	65	12,500,000
3	Construction large-scale cold storage	Domestic food prices	60	15,000,000
4	Construct large-scale steel silos for grain to enable import and storage during periods when prices on the international markets are low	Imported food prices	47	5,000,000

Specific technical needs

As the same suite of adaptation options have been selected as in the West Bank, the specific technical needs are also identical.

Specific capacity needs

Specific capacity needs also reflect those in the West Bank.

4.5.5 Gender

4.5.5.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Increasing the awareness of people, particularly women, in water-poor areas of measures they can take to help prevent major diseases	Major diseases related to water, sanitation, and food	76	2,200,000
	related to water, sanitation, and food			

Specific technical needs

Awareness campaigns need only promote measures associated with existing regulations and technologies in the State of Palestine.

Specific capacity needs

Although the necessary knowledge and skills to develop and implement the awareness campaigns are available in the State of Palestine, there are two Departments at the Palestinian Ministry of Health that would benefit from training.

4.5.5.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Increasing the awareness of people, particularly women, in water-poor areas of measures they can take to help prevent major diseases related to water, sanitation, and food	Major diseases related to water and sanitation	71	3,200,000
2	Supporting improvements in efficient use of water in women's private small-scale agricultural projects	Employment and gender	62	3,000,000
3	Encouraging women to use their house gardens to produce food	Food security and gender	61	3,200,000

Specific technical needs

As with the West Bank, awareness campaigns need only promote measures associated with existing regulations and accessible technologies. Supporting improvements in efficient use of water in women's private small-scale agricultural projects could be achieved through measures already deployed in the Gaza Strip, such as modern irrigation techniques and plastic houses. Using house gardens to produce food could be also informed by readily accessible techniques.

Specific capacity needs

Specific capacity needs in relation to awareness campaigns mirror those in the West Bank. Women require training in how to make more efficient use of water in their small-scale agricultural projects but have adequate existing knowledge and skills to use their house gardens to produce food.

4.5.6 Health

4.5.6.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Development of water, food and sanitation monitoring and safety systems using high technology	Major diseases related to water, sanitation, and food	66	5,850,000
2	Training health professionals and increasing the awareness of people, particularly women, in water-poor areas about measures they can take to help prevent major diseases related to water, sanitation, and food	Major diseases related to water, sanitation, and food	65	2,680,000

Specific technical needs

Development of water monitoring and safety systems using high technology can be implemented by reviewing available technologies in other countries and importing the best available suited to the West Bank. Training programs and awareness campaigns need only promote measures associated with existing regulations and technologies in the State of Palestine.

Specific capacity needs

Health professionals would need to be trained in use of the monitoring and safety systems. Specific capacity needs in relation to awareness campaigns mirror those in the West Bank with regard to gender (above).

4.5.6.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Training health professionals and increasing the awareness of people, particularly women, in water-poor areas about measures they can take to help prevent major diseases related to water, sanitation, and food	Major diseases related to water, sanitation, and food	70	850,000
2	Development of water, food and sanitation monitoring and safety systems using high technology	Major diseases related to water, sanitation, and food	66	2,900,000

Specific technical needs

Technical needs in relation to the selected adaptation options are the same as identified for the West Bank

Specific capacity needs

Capacity needs are also the same as in the West Bank.

4.5.7 Industry

4.5.7.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Providing reliable electricity supply	Energy supply	71	29,400,000
2	Replace imported raw materials with local materials whenever possible	Value of raw materials imported	61	28,000,000
3	Improve water supply through wastewater collection and treatment systems	Infrastructure	52	58,000,000
4	Reducing energy consumption through introduction of modern production technologies	Energy demand	44	31,000,000
5	Building fossil-fuel storage facilities	Energy supply	32	25,400,000

Specific technical needs

Local electricity companies have access to the necessary technology for upgrading the grid to increase the reliability of the energy supply. However, there are specific technical needs in relation to all of the other adaptation options. Replacing imported raw materials with local materials demands research and potential changes in production processes. Some suitable technologies to enable greater use of local materials will be available in the State of Palestine but some would need to be imported. The necessary technology to improve wastewater collection is available, however, technologies to deal with treatment of industrial wastewater would need to be imported. Modern production technologies that have the potential to reduce energy consumption are not available and would also need to be imported, as would technology associated with large-scale, fossil-fuel storage facilities (see energy sector above).

Specific capacity needs

There is a general lack of knowledge and skills in relation to the various adaptation options selected for this sector and consequent training needs. As noted for the energy sector (above), local electricity companies would benefit from training to improve their emergency response to interruption of the electricity grid, especially the high voltage network, during extreme weather conditions. Lack of relevant knowledge and skills regarding replacement of imported raw materials with local materials inhibits progress and specialized and professional training is required. Training and capacity building is needed to deal with industrial waste water; its collection and treatment. Palestinians also need training to fill gaps in knowledge and skills with regard to advanced energy efficient technologies that have potential to reduce energy consumption. Training needs in relation to building fossil-fuel storage facilities have already been described for the energy sector (above).

4.5.7.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Improve handling, fumigation, packaging, and	Value of raw materials exported	71	1,000,000

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
	storage techniques for raw materials intended for export			
1	Capacity building to enable industries to adapt to climate change	Employment	71	4,000,000
1	Rehabilitation of industrial facilities	Value of industrial products exported	71	30,000,000
4	Conducting energy audits in order to increase industries' use of energy efficiency measures	Energy demand	70	5,500,000
5	Provision of suitable storage facilities for industrial products intended for export	Value of industrial products exported	65	18,000,000
5	Rehabilitation and maintenance of industrial equipment	Energy demand	65	9,000,000
7	Providing reliable electricity supply	Energy supply	41	10,000,000

Specific technical needs

There are no specific technical needs in the Gaza Strip regarding any of the adaptation options selected for this sector, as relevant technologies and techniques are readily accessible. However, dependent on the industry, capacity building to enable industries to adapt to climate change may require techniques that are available locally or may need to be sourced internationally.

Specific capacity needs

Although some level of knowledge and skills exists on which to build in relation to each of these options, a wide range of training needs have been identified:

- People involved in handling, fumigation, packaging and storage need training in best practices.
- The level of available knowledge and skills to provide capacity building to enable industries to adapt to climate change varies by industry and may need to be outsourced internationally.
- Training will be required to ensure that the rehabilitation of industrial facilities takes climate change into account.
- Knowledge and skills are available locally to conduct energy audits but training could be required to implement some energy efficiency measures, e.g. installation and use of new equipment.
- Knowledge and skills are available locally to rehabilitate and maintain industrial equipment. Some training courses are needed for the professional on maintenance
- Skills and knowledge in providing reliable sources of energy are readily available but some training could be needed with regard to sources that are used less commonly in the Gaza Strip, e.g. renewable energy.

4.5.8 Terrestrial ecosystems

4.5.8.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	National network of protected areas, including 50 protected areas and 51 biodiversity hotspots	Habitat connectivity	66	12,000,000

Specific technical needs

National habitat maps were produced in 1995-96, were recently updated, and published in March 2016. This latest assessment includes identification of biodiversity hotspots and assessment of actions required to maintain and increase habitat connectivity. The resultant outputs are being input to development of the cross-sectoral National Spatial Plan. The work is being undertaken by consultants and Palestinians lack access to suitable software, e.g. for remote sensing, GIS, and landscape ecology. It is a Convention on Biological Diversity commitment in relation to the Cartagena Protocol to prepare a national framework on biosafety, e.g. in relation to genetically-modified organisms (GMOs). This has not yet been implemented. There are currently no measures in place for enabling rehabilitation of wildlife casualties, and there is a need to establish a wildlife rehabilitation centre.

Specific capacity needs

An assessment of national habitat maps is currently being undertaken by consultants and there is a need to train Palestinians in remote sensing, use of geographic information systems (GIS), and landscape ecology. There are few national taxonomic experts and very few with scientific training. There is a lack of research and scientific publications on the State of Palestine's biodiversity, although there are many publications for a general readership, particularly on birds. There is a need to build decision-makers understanding of the central importance of sustaining and restoring biodiversity and ecosystem services from a socioeconomic perspective in order to mainstream biodiversity conservation across sectors. There is a general lack of awareness about the importance of nature protection and a need to increase public appreciation of biodiversity.

4.5.8.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	National network of protected areas, including Wadi Gaza and 3 biodiversity hotspots	Habitat connectivity in Wadi Gaza	66	1,400,000

Specific technical needs

The description of technical needs for the West Bank also applies to the Gaza Strip.

Specific capacity needs

Specific capacity needs are also the same as those in the West Bank.

4.5.9 Tourism

4.5.9.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Identify, design and implement flood management schemes for cultural heritage sites, where appropriate	Condition of cultural heritage	61	4,800,000
1	Identify, design and implement flood management schemes for eco-tourist attractions, where appropriate	Condition of cultural heritage	61	4,800,000

Specific technical needs

It is anticipated that any flood management scheme would make use of existing technologies already deployed in the State of Palestine.

Specific capacity needs

The necessary knowledge and skills are available in the State of Palestine. Consulting engineers could design the required infrastructure, while construction companies could build it. There would be no need for external experts.

4.5.10 Urban and infrastructure

4.5.10.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Promoting green buildings	Urbanization	70	10,000,000
2	Rehabilitation of resilient road infrastructure	Urbanization	61	21,000,000

Specific technical needs

Green buildings are addressed by existing regulations. Both adaptation options can make use of available technologies, although it would be beneficial to introduce the latest green-building technologies to the State of Palestine.

Specific capacity needs

The necessary knowledge and skills for enhancing existing regulations for green buildings and for raising engineers' awareness of green buildings are available in the State of Palestine, but would be worth upgrading. Likewise, local consulting engineers and construction companies have the necessary knowledge and skills to undertake design and construction improvements to the road infrastructure. There would be no need to draw upon international experts.

4.5.10.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Rehabilitation of resilient road infrastructure	Urbanization	61	10,000,000
2	Promoting green buildings	Building conditions	60	12,600,000

Specific technical needs

See the West Bank above.

Specific capacity needs

See the West Bank above.

4.5.11 Waste and wastewater

4.5.11.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Improving waste collection system	Waste management	61	34,250,000
2	Improve management of leachate from landfill sites	Waste management	57	5,000,000
3	Reduce, re-use, recycle	Waste management	56	8,000,000

Specific technical needs

Inadequate waste collection is already a serious issues and improving the current system is identified as a priority in the draft National Strategy for Solid Waste Management in Palestine 2016-2020. There would be a need to import new collection vehicles and equipment for transfer stations, e.g. loaders and transfer vehicles. Communal bins could be manufactured locally.

The current situation is that management of leachate from landfill sites relies on natural processes, governed by rainfall. As such, leachates are already concentrated and any worsening of the current situation will be unacceptable. The National Strategy for Solid Waste Management in Palestine 2010-2014has expired. A first draft of the strategy for 2016-2020 includes a need to improve waste management in sanitary landfill sites was prepared. Leachate management is specifically mentioned. There is a need to switch from a reliance on natural evaporation to a new process, reverse osmosis, which uses a sophisticated nano-filtration technology. This would need to be imported from the EU or other available sources.

Reduce, re-use, recycle would require import of equipment for sorting at source, on transfer, and on disposal, as well as for subsequent recycling

Specific capacity needs

There would be a need to provide a short training program on improving the waste collection system specifically with regard to design of the routing system, e.g. in use of GPS and management information systems

With regard to improving management of leachate from landfill sites, there is no existing experience of reverse osmosis in the State of Palestine. There would be a need to increase Palestinian's capacity to manage the process through conducting a short training program.

There would be a need for short training programs on use of recycling equipment for sorting.

4.5.11.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Improving waste collection system	Waste management	65	12,000,000
2	Improve management of leachate from landfill sites	Waste management	57	2,000,000
3	Reduce, re-use, recycle	Waste management	56	2,000,000

Specific technical needs

See West Bank above.

Specific capacity needs

See West Bank above.

4.5.12 Water

4.5.12.1 West Bank

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Rehabilitate water sources: wells, canals and springs	Condition of infrastructure	70	4,400,000
2	Control of leakage from distribution systems	Condition of infrastructure	65	16,500,000
3	Allocate transboundary water resources equitably and reasonably between Israel and the State of Palestine	Groundwater supply	62	117,600,000
4	Enhance the use of additional and alternative water resources for non-domestic purposes	Groundwater supply	51	152,000,000
5	Develop and improve storm-water systems and drainage infrastructure	Flood management	40	20,800,000

Specific technical needs

All of the adaptation options would make use of existing technologies and techniques available in the State of Palestine.

Specific capacity needs

Knowledge and skills would be available to implement all of the adaptation options (except for the construction of large dams), drawing upon local construction companies and construction engineers as necessary. There would be no need to seek input from international experts except in relation to large dams. Some capacity building might be beneficial in relation to rehabilitating wells, canals and springs.

4.5.12.2 Gaza Strip

Rank	Adaptation option	Highly vulnerable	Score	Total estimated cost (USD)
1	Increase share of imported water	Groundwater supply	81	1,000,000
2	Enhance the use of alternative water resources for non-domestic purposes	Groundwater supply	66	61,000,000
3	Build a large desalination plant for Gaza[248]	Groundwater quality and supply	56	510,000,000
4	Develop and improve storm-water systems and drainage infrastructure	Flood management	51	10,200,000

Specific technical needs

Like the West Bank, existing technologies and techniques are available in the Gaza Strip except with regard to building and operating the desalination plant, which could be achieved through reviewing available technologies in other countries and importing the best available suited to the Gaza Strip.

Specific capacity needs

Local knowledge and skills would be available to implement all options with the exception that water professionals would need to be trained to operate the large desalination plant.

4.6 Future developments to participate in climate-change modelling research

The main recommendation arising from the review of requirements for the State of Palestine to have the capability to generate its own climate modelling inputs to its future NAPs and NCs was to ensure that the fundamental requirements for undertaking climate change analyses are in place prior to developing local modelling capabilities. These fundamental requirements include:

- The development of observations systems to World Meteorological Organization (WMO) standards
- Digitisation and quality control of all observational data
- Creation of digitised databases for historical observations and for ingestion of future data, with quality control
- Consideration of staff training requirements
- Consideration of the use of existing global observations datasets, as input to research on Palestinian climate
- Consideration of the use of existing IPCC projections datasets, as the first stage towards research on climate change in the State of Palestine
- Development of links with international institutions to assist where appropriate in all studies.

At this time, it was recommended that any initial downscaling approach considered should be progressed through statistical means and not through use of numerical models. If numerical modelling is to be used then technical details need to be considered in consultation with the selected modelling house. However, it should be recognised that the use of a single model is not recommended, and that all work should be based on ensembles, ideally with combinations of global and regional models. The

[248] Like all adaptation options listed here, this project is a high priority. It is viewed by the Palestinian Government as an urgent priority. It ranks lower than the options above it, in part, due to its substantial cost.

CORDEX dataset provides an extensive resource for research at this time, which might be considered for initial work. The current state of knowledge suggests that numerical downscaling is most useful by coasts and over regions of marked topography; the former might apply to the Gaza Strip but the topography of the West Bank may be insufficient to benefit from the latter. Consideration should be given to Chapter 9 of the IPCC AR5 Working Group I report, in particular Section 9.6 onwards, prior to any final decision on implementing numerical downscaling. If work is to be progressed then it is recommended that it should be undertaken in cooperation with the CORDEX project.

Full details of the review can be found at the NAP's Appendix 5 and resultant costings provided by the Palestinian Meteorological Office can be found at the NAP's Appendix 6. Total cost is estimated as USD 2,120,000.

4.7 Monitoring and evaluation

The development of a monitoring and evaluation process in relation to the NAP will consider possible options for monitoring, as relevant to each of the 'highly vulnerable' issues, in terms of changes in:

- Their climate sensitivity and/or
- Related adaptive capacity and/or
- Their vulnerability and/or
- Related direct and indirect impacts that may be attributed to climate change and/or
- Progress with implementation of related adaptation options.

While steps could be taken to address the current lack of quantitative national datasets in relation the 'highly vulnerable' issues (and their component climate sensitivities and adaptive capacities), the simplest monitoring solution would be to replicate the process used here to identify and prioritize vulnerabilities and adaptation options each time the NAP is reviewed and updated.

4.8 Alignment of donor programs and activities with the NAP's focal themes/sectors

Chapter 7 of the INCR includes a section on "Establishing and enhancing climate finance readiness". It notes that now that the State of Palestine is a party to the UNFCCC, EQA has been selected as the Country's National Designated Authority (NDA) to the Green Climate Fund (GCF). In this context, an important next step is to identify how donor programs and activities align with the vulnerabilities and adaptation options prioritised by the NAP process. An initial review has identified the following donor programs:

- United Nations Development Assistance Framework for the State of Palestine and Program of Assistance to the Palestinian People (UNDP-PAPP)
- Palestinian Recovery and Development Plan Multi Donor Trust Fund Project (PRDP TF), involving the World Bank
- EU Palestine Single Support Framework (EU SSF)
- Palestinian Territory Belgium Partnership, Belgian Development Cooperation (BTC)
- German Development Cooperation (GIZ) programs on: Adapting to climate change (ACC); Adapting to climate change in the water sector in the MENA region (ACCW); and Open Regional Fund (ORF MENA)
- Swedish Development Cooperation (SIDA) with Palestine
- UK Department for International Development (DfID) Palestinian Program.

In addition, there are multilateral funds linked to UNFCCC, including the Global Environment Facility (GEF), GCF, Adaptation Fund, Special Climate Change Fund, and others. Additional bilateral funding mechanisms are also available for the State of Palestine to access.

Potential links between some of these donor programs and the vulnerable theme/sectors on which the NAP is focused are identified in Table 28. Although the links have been identified from what has been funded previously and from donor and program documentation, it should be noted that the latter may not be up-to-date and will be subject to change over time.

Table 28: Potential links between donors and programs and the NAP's vulnerable theme/sectors

Theme/Sector	Donor programs
Agriculture	UNDP-PAPP; PRDP TF; EU SSF; GIZ ACC;
Coastal and marine	UNDP-PAPP; EU SSF;
Energy	UNDP-PAPP; EU SSF;
Food	UNDP-PAPP; PRDP TF;
Gender	UNDP-PAPP; PRDP TF; EU SSF; BTC
Health	UNDP-PAPP; PRDP TF; EU SSF; BTC; GIZ ORF MENA; SIDA; DfID
Industry	EU SSF; SIDA
Terrestrial ecosystems	UNDP-PAPP; BTC
Tourism	UNDP-PAPP; EU SSF;
Urban and infrastructure	UNDP-PAPP; EU SSF; BTC
Waste and wastewater	UNDP-PAPP; EU SSF; BTC; DfID
Water	UNDP-PAPP; PRDP TF; EU SSF; GIZ ACC; GIZ ACCW; SIDA; DfID

4.9 Next steps

In relation to individual themes/sectors or adaptation options, follow on work (inclusive of stakeholder consultation) could usefully address:

- Development of detailed funding proposals for international donors, international financial institutions and international funds
- Review of the Palestinian Government's thematic/sectoral strategies and policies to ensure that they are aligned with the NAP and thereby integrate and mainstream climate change adaptation
- Planning implementation of adaptation options (including spatial plans where data allow)
- Establishing new data requirements for future enhancement of the NAP and monitoring and evaluation (including indicator development)
- Capacity building and training (including for all other activities in this list).

4.10 Conclusions

The Climate Change Adaptation Strategy and Program of Action for the Palestinian Government[249], previously identified water and food security as the most vulnerable issues in the State of Palestine with knock-on implications for all other themes/sectors. In keeping with those conclusions, the latest comprehensive assessment identified a wide range of 'highly vulnerable' issues in relation to water, agriculture and food that also affect the vulnerability of other themes/sectors. However, it also importantly revealed that many 'highly vulnerable' issues have inter-connections more generally across themes/sectors, most notably, in addition to water, agriculture and food, in relation to energy.

The assessment revealed that Israeli occupation substantially reduces the State of Palestine's adaptive capacities in relation to many issues across all themes/sectors thereby compounding climate vulnerabilities. For example, Israeli occupation of the State of Palestine restricts: availability of land and resources and degrades them; freedom of movement of goods and people; import and export of raw materials and products; development of domestic and industrial infrastructure; and abilities to respond

[249] UNDP, 2010. Climate Change Adaptation Strategy and Program of Action for the Palestinian Authority.

to inter-related crises. These limitations on the State of Palestine's adaptive capacities are most prevalent in Area C (which covers 61% of the West Bank) and in the Gaza Strip, but Israeli occupation also increases vulnerabilities elsewhere. Hence, many issues rated as 'Vulnerable' without Israeli occupation have been rated as 'highly vulnerable' when Israeli occupation is taken into account.

Each of the adaptation options in the NAP is uniquely ascribed to a particular vulnerability within a theme/sector and will be the responsibility of the relevant Palestinian Government's Ministry for that theme/sector to deliver. However, many of the adaptation options provide co-benefits for multiple themes/sectors and their delivery will be of considerable interest to other Ministries and all related stakeholders. The Environment Quality Authority will maintain oversight and ensure coordination across all themes/sectors. The NAP has received approval from all relevant Ministers and the Palestinian Government's thematic/sectoral strategies and policies now need to be reviewed to ensure that they are aligned with the NAP and thereby integrate and mainstream climate change adaptation. This will help to secure funds for proposed national programs and projects.

The NAP will be maintained as a living document that may be reviewed on an ongoing basis by theme/sector in accordance with the systematic processes that have been used to identify and prioritise vulnerabilities and adaptation options. This is considered particularly important for some themes/sectors where thinking is less advanced and there is a need to build upon the scope and scale of adaptation options if they are to be commensurate with the challenges posed to the 'highly vulnerable' issues by the three climate scenarios.

All adaptation options identified in relation to 'highly vulnerable' issues have been included in the NAP, irrespective of their ranking. However, this remains a conservative approach as other 'vulnerable' issues have not been addressed. The adaptation options have each been prioritised in relation to the impact of them not being implemented, their efficacy in relation to all three climate scenarios, their timing and urgency for action, likely social acceptance, availability of suitable technologies and techniques, availability of relevant knowledge and skills, their costs, co-benefits for adaptation in other themes/sectors and co-benefits for mitigation. It is important not to compare the priority of adaptation options between the West Bank and the Gaza Strip or between themes/sectors, as relative scores have been used to rank options within each theme/sector.

It is self-evident that as Israeli occupation compounds climate vulnerabilities by reducing adaptive capacities, it also severely constrains the State of Palestine's abilities to adapt. Israeli restrictions are particularly challenging for options that require import of new technologies, import and export of raw materials and products, or the development of domestic and industrial infrastructure. Hence, unless lifting of these restrictions can be resolved with Israel, it may be much more difficult for the State of Palestine to adapt to projected climate change with potentially dire consequences.

Although adaptation options make use wherever possible of existing technologies and techniques available in Palestine, a considerable number do require their import. Many of the adaptation options also draw upon existing knowledge and skills available in Palestine but there are substantive needs for technology transfer, training and capacity building. It is these aspects and the scale of necessary implementation that drive financial needs, which are considerable, in total in excess of USD3.5 billion over the next ten years. Hence, the State of Palestine's ability to implement its NAP will be reliant on securing substantial financial support from international donors in addition to technology transfer and capacity building.

5 Constraints and gaps, and related financial, technical and capacity needs

There are constraints and gaps and related financial, technical and capacity needs for three main elements presented in this INCR: GHGI, mitigation and adaptation.

5.1 GHGI

The creation of the GHGI is a significant step forward for the State of Palestine. It has completed an inventory for the period 2006-2013. However, Palestine aims to continue improving its inventory and to report these improvements in future NCs.

5.1.1 Constraints and gaps

There are a number of constraints and gaps that are currently preventing the State of Palestine making the necessary improvements to its GHGI. The priority areas for improvement are set out below.

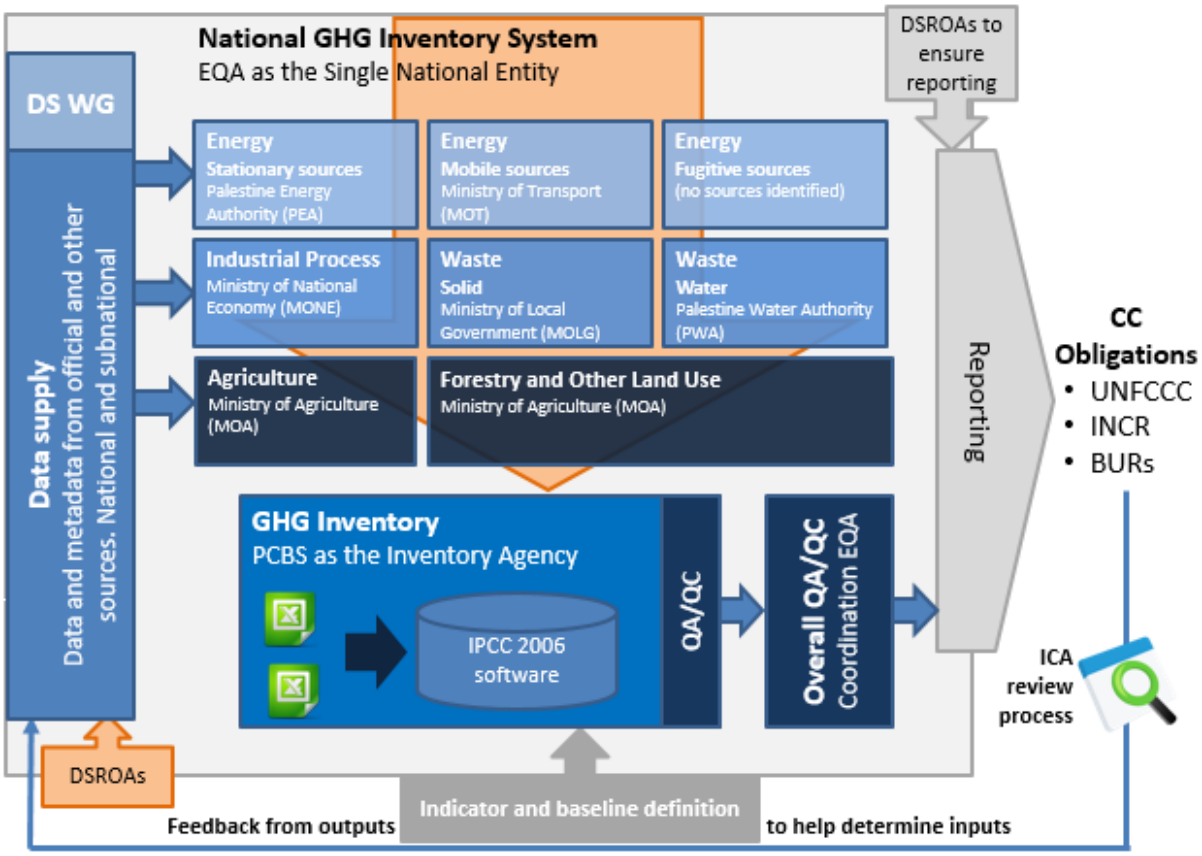
Capacity building

The development of the GHGI has been carried out with the active participation of the Palestinian core GHGI team and a number of other stakeholders. Basic capacity building has been done to train the core team in the essentials of data collection, the compilation, reporting and quality control of a GHGI. Further work is needed, particularly to improve the capacity to improve the quality of key sets of activity data for all sectors, including the energy statistics. Ideally this would be delivered through a combination of formal workshops, further thematic review and improvements of the GHGI, and one-to-one mentoring.

Institutional arrangements

The framework for the institutional arrangements necessary to maintain and update the GHGI and create future national communications have been set out in this INCR. Responsibilities and tasks have been clearly allocated to specific organizations. The State of Palestine is actively implementing these arrangements. The challenge will be to fully implement these arrangements, so that future reporting obligations can be reliably and repeatedly delivered. During the implementation of the institutional arrangements, it is likely that some challenges will arise and barriers will be identified. The organizations identified in Figure 40 below will need support to overcome any barriers, and to ensure the system becomes fully institutionalized and operational. The role of the EQA, as the coordinating body, and PCBS as the GHGI agency are particularly important.

Figure 40: National GHGI system



Acronyms are provided under Figure 25.

Data collection, processing and management

The GHGI agency and team at the PCBS has created a data library and inventory spreadsheet data processing and storage system, following elements of IPCC best practice in GHGI compilation. The team has also been trained in the basics of best practice and principles of data collection and management. The overall data-collection system needs further refinement to ensure it can adapt to new and improved sources of data. The approaches used to make calculations need to be documented and kept up-to-date.

Improving the completeness of activity data, and the data collection system

There are still data gaps that exist primarily because the necessary data is not being collected, or existing data has not yet been identified. This improvement work would be prioritized, and guided by the key category analysis. The next steps would be to confirm these data gaps and develop mechanisms to collect or estimate these data. For instance, data on industrial wastewater, industrial solid waste, incineration of waste, F-gas use, and land-use change are missing. Moreover, the transport sector is one of the key sources of GHG emissions in the State of Palestine and should be a key priority for data collection improvements. The Palestinian Government will encourage the relevant key data providers to start collecting data for these sources and sinks, and will work with them to make estimates where activity data are absent.

The need for data collection agreements should be investigated and agreements created if necessary. The State of Palestine would like to understand what practices are used in other countries.

Extending sectoral detail, improving accuracy and improving quality

By improving their data collection systems, the State of Palestine can improve the sectoral detail in its GHGI. There is a particular need for such improvements in the energy sector. The current energy balance lacks the necessary sectoral detail to make the GHGI as useful as it should be. The energy statistical team need to work with the GHGI team to ensure the energy statistics can, over time, provide the core data to underpin the inventory, and this will help prioritise mitigation efforts also. Support to

help strengthen the systems of the energy statistics team is needed. The effects of land-use changes will be introduced into the GHGI if the necessary data are available or satisfactory estimates can be made. The energy sector reference/sectoral approach inter-comparison is a key GHGI verification tool. There is a need to understand the differences in the results between these two approaches, and this will help prioritise sectoral improvements. This improvement task links to the need to improve the transparency of the energy statistics in general. The good practice in quality control and quality assurance measures that has already started to be introduced into the inventory systems should be extended to all the steps that are used to calculate and report emissions and guidance.

Enhancing the backup and storage facilities

A simple and effective backup and storage facility needs to be fully operationalized and maintained.

Awareness raising

Successful implementation of GHG mitigation activities, requires enhancing the public awareness and institutional coordination. Effective awareness raising campaigns are needed.

5.1.2 Updating the GHGI

The GHGI is mainly complete, but there is some work to be done. The Palestinian team are aiming to extend the sectoral detail and make improvements in accuracy (as shown above). The Palestinian team are aiming to update the inventory frequently to fulfil the reporting that is necessary in NCs and BURs.

Important work that needs to be done is:

- Continue to implement the creation of the institutional arrangements to allow the GHGI to be updated and reported
- Improve the data collection, processing, documentation and storage systems. This includes enhancing quality control and quality assurance activities
- Enhance the sectoral detail, which will involve making improvements to detail of the energy statistics
- Raise awareness to make sure that politicians and the general public understand the benefits and importance of the GHGI.

5.1.3 Related technical, financial and capacity needs

The Palestinian team needs technical and financial support to carry out the work to ensure the GHGI is complete and accurate, and to fully institutionalise the necessary inventory systems and processes.

Specific technical needs are:

- Further technical training on the approaches used to estimate emissions, and how to quality control the work done to create the estimates. Sessions tailored to each of the sectors and their specific needs are required, as well sessions relevant to all the stakeholders involved in the creation and reporting of the GHGI.

Specific financial needs are:

- Financial support for the training and capacity building activities
- Support for effective IT systems.
- Specific capacity needs are:
    - The capacity of the GHGI team needs to be strengthened. Simple succession and continuity planning is needed to ensure team can continue to function when staff change, or if there are short term problems with the availability of staff
- The key areas for capacity building are summarized here based on the constraints and gaps identified in Section 5.1.1:
    - Formal workshops and mentoring to identify and improve the quality of core sets of activity data for all sectors (including energy statistics, and technical and capacity support for LULUCF data collection)
    - Train institutions involved in the national GHGI system to allow them to deliver future reporting obligations repeatedly and reliably

- Train PCBS to refine the overall data collection system and to adapt to new and improved sources of data in line with good QA/QC practices
- Train the relevant ministries to improve data collection and in how to make estimates/assumptions when data is missing
- Support the energy statistical team to extend the sectoral detail of the energy sector and to understand the differences between the reference and sectoral approaches
- Support the State of Palestine in raising awareness about climate change to the general public.

5.2 Mitigation potential

The information in Chapter 3 shows that the major GHG emissions arise from energy use in the State of Palestine, including fuel use for transport. As such, priority mitigation options for the country are those that help reduce energy use or limit the increase in it. These options include solar PV, building energy efficiency, and the use of waste for energy (either for cement production or for electricity generation). Additionally, projects to pilot the use of CNG for taxis, and to improve public transport, have been proposed; as show in Section 3.8.

5.2.1 Constraints and gaps

Solar PV is a key mitigation technology for the State of Palestine, as for other countries with high levels of sunshine. Barriers identified already by the Palestinian Energy and Natural Resources Authority (PENRA) include enabling financing mechanism, professional skills, laboratory accreditation and quantifying externalities. Other barriers such as legal/ regulatory ones have already been addressed to some extent.

However, to reduce their dependency on imported electricity from Israel, the Palestinian Government has taken a number of steps for encouraging the development of renewable energy projects, the renewable energy law has been approved and signed by the president, a number of solar projects for generation of electricity have been developed, and PENRA issues generation license for solar plants according to the law.

For building energy efficiency, the key barrier identified is the ease or otherwise of enforcement of existing standards including Energy Code for Buildings[250]. Given existing resources, and the degree of control over territory, it appears that building developers do not feel the need to follow the standards. There may also be limited understanding of the options for energy efficient construction, and so training in this area should be explored. Moreover, planning is in the hands of municipalities, therefore, in order to deliver effective energy efficient buildings, activities need to be coordinated between the government, municipalities and Palestinian Engineers Association. Awareness raising is needed.

In the transport sector, barriers to CNG deployment for taxis are likely to include user acceptance – in other words, the willingness of taxi drivers to use this new fuel, in addition to infrastructure rehabilitation and reformation to handle the distribution and delivery of CNG. There may also be concerns about the reliability of CNG supply. Moreover, the cost of conversion could also be a barrier. To overcome this, international support and transfer of experiences will be required. Note that CNG-powered vehicles are assumed to be easier to deploy in the case of political independence and, for this reason, it is not expected that there will be any barriers related to Israeli actions.

For public transport, barriers are likely to be driven by the difficulties of co-ordination between the large numbers of operators. Provision of information to passengers and operators – a key element of improved public transport – may also be hampered if communications infrastructure is not adequate.

As part of improving public transport, it is also proposed to have new and more efficient buses. One possible issue here – particularly if those buses are hybrid buses – is the availability to repair the buses if they break down. Training of local repairers could be a useful supplementary activity to ensure the buses remain operational. In addition to public transport route optimization and fleet renovation.

[250] Ministry of Local Governments. Establishing, Adoption, and Implementation of Energy Codes for Buildings. http://www.molg.pna.ps/ecb/projects/projects.html

5.2.2 Updating the mitigation analysis

The State of Palestine's situation is changing rapidly and is likely to continue to do so in future. In addition, technologies will change in future and new information will become available. For these reasons, the mitigation analysis presented in this INCR will need to be updated regularly.

Performing mitigation analysis requires specialist skills and resources. Key barriers include: lack of staff skills and experience, budgets to allow staff to work on mitigation analysis, budgets to allow baseline data gathering to take place, and fundraising for mitigation projects, including NAMA and other international mechanisms.

Training in mitigation software (LEAP model) and inventory software (IPCC 2006 software) was provided during the preparation process of the INCR. However, skills need to be kept up-to-date and individuals may move to other roles or leave their organisation, taking their skills with them. An ongoing programme of training is, therefore, recommended.

5.2.3 Related technical, financial and capacity needs

To improve the mitigation analysis, data gathering needs to be a priority. The State of Palestine's situation makes this particularly difficult. In addition, data needs to go through a process of quality control before it is used. Where resources are limited, there is a need to enable systematic quality control of the data used in the analysis.

Specific technical needs are:

- Particular skills and resources needed include technical training of the relevant stakeholders to increase their understanding of the mitigation technologies that are available and could be used in the State of Palestine
- Technical training to share experience and best practice with the deployment of these mitigation technologies in similar regions (e.g. other parts of the Middle East).

Specific financial needs are:

- A key financing gap could be the provision of low-cost loans to support mitigation activities. As noted elsewhere, there are a number of projects that would deliver overall financial benefits to the State of Palestine, but which have high upfront costs. Most renewable energy projects fall into this category. Unless finance at reasonable rates is available, these projects may be delayed or may not happen taking into consideration the availability of technology transfer and capacity building
- Financial support for the training and capacity building activities
- Support for effective IT systems.

Specific capacity needs are:

- The relevant institutions need resources to participate in feasibility or pilot projects to prove the viability of new technologies within the State of Palestine
- Sector specific training on LEAP software targeted to the sectors where mitigation is likely to deliver the best options for a lower carbon development pathway
- Training on MRV of mitigation activities, including the use of indications to track progress and outcomes
- Training all stakeholders and relevant institutions with a role in implementing or monitoring mitigation activities to understand what would constitute a good quality and efficient data collection system and to adapt to new and improved sources of data and apply good QA/QC practices.

5.3 Vulnerability assessment and adaptation

The development of the NAP (2016) has adopted a systematic process for assessing vulnerabilities and identifying and prioritising adaptation options in accordance with the UNFCCC's technical guidance for least developed countries.

5.3.1 Constraints and gaps

Relevant scenarios presented in the literature have been reviewed to provide context for an analysis of projections from models used in IPCC's AR5, as a basis for identifying adaptation options. However, for Palestine to have the capability to generate its own climate modelling inputs to its future NAPs and NCs the following would be required:

- A comprehensive and readily accessible digitized database of ongoing weather and climate observations to World Meteorological Organization (WMO) standards[251]
- Similar databases to fulfil requirements for hydrological parameters
- Appropriately-qualified staff
- Computer resources.

While approximately 20 relevant studies on the State of Palestine have been published since the Climate Change Adaptation Strategy and Programme of Action for the Palestinian Authority (2010), there remains a lack of quantitative and spatially explicit data. This has some implications on NAP's development and on the vulnerability assessment and identification of adaptation options, which are simply addressed to the West Bank and/or the Gaza Strip. This places some limitations on future monitoring and evaluation of the NAP.

5.3.2 Updating the adaptation analysis

The process of developing the NAP was led by an international expert who supported the team of national experts from Palestinian universities and briefed stakeholders at a series of workshops held at key stages in the NAP's development. In turn, the national team facilitated stakeholder input to the vulnerability assessments for each theme or sector and to the identification and prioritisation of adaptation options. The final NAP was then quality assured by the international expert. This emphasis on capacity building means that when the NAP is next updated it should be relatively simple for national experts and stakeholders to review the vulnerability assessment and progress with implementation of the adaptation options. However, quality assurance by an international expert is recommended to ensure adherence to the same process. A consistent approach will enable any change in perceived vulnerabilities to be used as a measure of the success or otherwise of adaptation actions during the intervening period.

5.3.3 Related technical, financial and capacity needs

Prioritisation of adaptation options for the NAP has identified in each case where technology or knowledge and skills within the State of Palestine are lacking and the necessary steps required to enable their implementation, e.g. import of relevant technologies or capacity building. Estimated costs of each adaptation option have been identified for Years 1-5 and 6-10. Further details can be found in the Vulnerability & Adaptation Chapter 4.

[251] World Meteorological Organization, Global Observing System (GOS). ttp://www.wmo.int/pages/prog/www/OSY/GOS.html

6 Other information considered relevant to the achievement of the objective of the convention

6.1 Transfer of technologies

To date, there has been limited technology transfer to the State of Palestine. There is a well-established market for solar thermal, a developing market for PV, and energy efficiency technologies have also been introduced (e.g. energy efficient lighting).

Other green technologies for both mitigation and adaptation options have yet to penetrate the Palestinian market. The penetration has been limited mainly due to the fact that the State of Palestine was not a party to the UNFCCC until the preparation of this INCR. However, now that the country is a party to the UNFCCC, it is planning to increase the rate of technology transfer in order to be able to efficiently implement its climate plans. As such, the implementation of the NAP and mitigation discussed previously in this communication, are highly dependent on providing the State of Palestine with the transfer of suitable technologies.

Technology transfer is also key for all domains in the State of Palestine such as climate modelling and observations, transport, water management, agriculture management, infra structure, renewable energy and energy efficiency, health, surveillance systems and for the development of adequate monitoring systems among others.

6.2 Research and systematic observation

Climate change research and systematic observation are crucial for any country to clearly understand how it can actively and effectively participate in global activities to tackle dangerous climate change. Palestine is a developing country and faces limited financial resources available for climate research.

Despite the financial and technical obstacles, the State of Palestine has still made an effort to conduct various studies and research programs to understand the challenges and benefits of climate change mitigation and adaptation. The development of this INCR has also facilitated research and compiled the outcomes on key areas of mitigation and adaptation such as historic climate trends, climate change scenarios, vulnerability and adaptation, GHG inventories and mitigation potential. Table 29 below highlights the key areas of recent and previous research based on the categories provided in the decision 2/CP.7 (Article 15 of the Annex of the decision). It also includes various regional research projects on climate change presented primarily in the “water” category.

Table 29: Some areas of national and regional research

Area of research	Project
Capacity building	In April 2015, under EQA supervision, Triple E and Climatekos in collaboration with UNDP/PAPP, UNEP and the Belgian Development Cooperation released a Capacity Development Program (NCDP) based on priority capacity development needs entitled “Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority.”[252]
National communications	Research to enable the development of this INCR has been conducted.
National climate change programmes	The State of Palestine, represented by the Environment Quality Authority (EQA), took the lead in developing the “National Climate Change Adaptation Strategy” with support from UNDP/PAPP. Stakeholders representing all sectors, including officials, researchers, representatives of NGOs, CBOs and local communities, were actively involved in preparation of this national strategy.

[252] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.

Area of research	Project
	In an effort to identify the key climate change related needs for the Arab region, the League of Arab States and the Arab Center for the Studies of Arid Zones and Dry Lands prepared a strategy for scientific research linked to climate change for the Arab Region in 2010.
GHG inventories, emission database management, and systems for collecting, managing and utilizing activity data and emission factors	This research has been conducted as part of developing this INCR. See Table 30 for more information.
Vulnerability and adaptation assessment	The State of Palestine's National Adaptation Plan (NAP, 2016) identified a strategic need to focus on reducing water insecurity and food insecurity. The UNFCCC's guidance for least developed countries was followed, and the definition of vulnerability in the IPCC's AR5 was used in order to embrace uncertainties. Vulnerabilities across 12 themes (Agriculture; Coastal and marine; Energy; Food; Gender; Health; Industry; Terrestrial ecosystems; Tourism; Urban and infrastructure; Water, wastewater and solid waste) were assessed from analysis of climate sensitivities and adaptive capacities, which were reviewed and ranked by stakeholders. Adaptation options in relation to the key vulnerabilities were then identified and prioritized by stakeholders with reference to climate change scenarios for the State of Palestine.
Research and systematic observation, including meteorological, hydrological and climatological services	Historic trends in climate in relation to the State of Palestine have been assessed as a context for considering the climate sensitivity of potential vulnerabilities across the State of Palestine's various sectors in preparing the NAP and INCR). The assessment has comprised: global analyses of observed trends in relation to the State of Palestine interpreted from the IPCC's Fifth Assessment Report; a review of climate trends assessed at a national level in documents submitted to the UNFCCC for countries in the vicinity (i.e. Lebanon, Jordan, Israel and Egypt); and a summary of papers in the peer-reviewed or grey literature that consider regional climate trends in and around Palestine.[253]
Climate change scenarios	Climate-change scenarios have been produced, based on the latest science, for use in the development of the State of Palestine's NAP and for inclusion in this INCR. Relevant scenarios presented in official perspectives submitted in National Communications to the UNFCCC from countries in the vicinity (i.e. Lebanon, Jordan, Israel and Egypt), and selected perspectives from the peer-reviewed or grey literature were reviewed to provide context for an analysis of projections from models used in the IPCC's Fifth Assessment Report (AR5).[254]
Energy efficiency	Different energy audit projects were implemented by PENRA that showed a high potential in reducing electricity bill and mitigate emissions
Renewable energy	In 2014, the UNDP/PAPP released a report entitled "assessment of Solar PV initiatives in Gaza formulating public building scaling up programme"
Water	The GLOWA (Global Change and the Hydrological Cycle) project funded by the German Federal Ministry of Education and Research (BMBF) has the aim to develop simulation-tools which will help to realize a sustainable water management under global change conditions. The GLOWA Jordan River project is an interdisciplinary project addressing the future of the water scarce Jordan River basin under the impact of climate and global change. The forty research teams taking part in GLOWA Jordan River, whose membership is made up of scientists and stakeholders from Germany, Israel, Jordan and Palestine, are working in the belief that their findings will help ensure that future management of the water resources of the area is effective and will provide a good example of improved water management.[255]

[253] See NAP, Appendix 1
[254] See NAP, Appendices 4 and 5
[255] For more information on the GLOWA project: http://www.glowa.org/eng/jordan_eng/jordan_eng.php

Area of research	Project
	The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) is an outcome of a collaborative effort between the United Nations and the league of Arab States (LAS) and respective specialized organizations to respond to the request of the Arab Ministerial Water Council and the Council of Arab Ministers Responsible for the Environment to deepen the understanding of the impact of climate change on water resources and its associated implications for socio-economic vulnerability in the Arab region. The Regional Initiative aims at assessing the impact of climate change on freshwater resources in the Arab Region through a consultative and integrated assessment that seeks to identify the socio-economic and environmental vulnerability caused by climate change impacts on water resources in the Arab region[256]. The PWA and UNDP are currently implementing climate change modelling for a specific catchment area. Research on water scarcity has also been conducted under the CLICO (Climate change, hydro-conflict and human security) project funded by the 7th framework programme and the EU. This project aimed to answer the following question: "Will climate change undermine human security in the region by intensifying water hazards?" [257]

If extra funding is provided, the State of Palestine could increase its research scope to include all areas of scientific research related to climate change. This is important as the State of Palestine is extremely vulnerable to effects of climate change.

6.3 Education, training, and public awareness

The State of Palestine has undertaken various efforts to educate, train and raise public awareness on climate change. For instance, the EQA prepared a "National Strategy for Environmental Awareness and Education"[258] with support from UNDP in 2014 which clearly places climate change as a key area. Moreover, during the COP 21 in Paris, the State of Palestine hosted an official side event entitled "Climate Change Planning in Conflict Settings: Case of the State of Palestine". To watch a recording of the event please see this link[259]. The event was well attended and engaged the audience with the difficulties of undertaking climate change efforts, both adaptation and mitigation, while facing extreme and continuous pressure from Israel's occupation.

Others methods can also be undertaken to increase education and awareness. The participation of the State of Palestine and different Palestinian stakeholder groups in various international events on climate change, in particular under the UNFCCC (i.e. Action for Climate Empowerment (ACE) platform) and the IPCC needs to be strengthened. A key element with regard to strengthening the national capacity and research on climate change is the intended plan to establish a National Center of Excellence on Climate Change (NCECC). This Center would host a dedicated technical team to conduct climate-related research, and support the PCBS in implementing and updating the GHGI and the NC. It would also support various government ministries and agencies in need of technical and scientific advice and would work to improve coordination between them. In addition, a climate change technical/scientific pole is to be created to establish a proper link to the engineering, industry and business communities. Palestine engagement in Climate Technology Centre and Network (CTCN) processes and modalities of support will notably enhance national climate-related efforts in the areas of technology development and transfer, research and awareness-raising.

Schools and universities could integrate climate change aspects in some of their courses and teachers could be trained on various aspects of climate change. This will ensure the supply of the university courses and schools in the State of Palestine with the required human and educational resources to fully integrate climate change aspects. Next to these training modules, the NCECC could also

[256] For more information: http://www.escwa.org.lb/RICCAR/ri.asp?ReferenceNum=RI
[257] For more information: http://www.clico.org/
[258] UNDP, State of Palestine and Government of Sweden (2014) National Strategy for Environmental Awareness and Education 2014-2020.
[259] Side event held at COP 21 in Paris (2015). Climate Change planning in conflict settings: Palestine https://onedrive.live.com/?authkey=%21AFswUMD0jLfQq3E&cid=F34AC61ECF113902&id=F34AC61ECF113902%216788&parId=F34AC61ECF113902%216744&o=OneUp

coordinate the establishment of a national study and research program on socio-economic and ecological systems and their evolution under climate change. Last but not least, the NCECC together with other local expert organizations, including from the technical pole, could establish two further key training programs could be established for different levels and groups of stakeholders. First, an ongoing, general climate-change training program for key government and further implementing organizations. Second, a climate-change capacity building program on adaptation and mitigation for consultants and specialized NGOs working on climate change.[260]

Finally, creating a website on "Climate Change in the State of Palestine" which includes annual reports, studies, scientific research and articles, and material and data produced as part of the preparation of the NCs could also be an easy way to educate and raise awareness on climate change issues in the country.

6.4 Capacity building

Capacity building is crucial to the State of Palestine and should assist it to build, develop, strengthen, enhance, and improve its capabilities to achieve both the objectives of the UNFCCC and its national goals. The State of Palestine has engaged in capacity building at both the activity level and at the governance and institutional level.

6.4.1 Capacity building activities and capacity enhancement needed

The existing staff need to participate in further capacity building activities, for example technical training, and sufficient staff are needed to fulfil the climate obligations of the State of Palestine, which may mean capacity enhancement is required.

Chapter 5 has highlighted the key needs for capacity building and capacity enhancement in relation to:

- GHG inventories (see Section 5.1.3)
- Emission projections and development of mitigation options (see Section 5.2.3)
  Vulnerability and adaptation assessments (see Section 5.3.3).

However, there are other key areas that also need capacity building described below.

6.4.1.1 National meteorological services

The State of Palestine lacks a complete and comprehensive national monitoring system within a cohesive climate research framework but does have a national meteorological service that is currently facings various challenges and needs substantial technical, financial and capacity building support to implement its responsibilities. It is facing high demand to provide timely, and value added quality information, services and products but is encountering problems regarding data processing and forecasting systems. Moreover, it lacks observational network stations which is the engine of meteorological services. There is also need for human capacity building and training of staff. The national meteorological service recently highlighted the key elements they need to enhance their capacities and the associated costs in order to improve their research and observation patters. It is important to note that the PCBS does play a critical role in national data collection and analysis for the country but does not focus specifically on carrying out systematic observations for specific climate targets.

6.4.1.2 Climate modelling as part of the national meteorological services

For the State of Palestine to have the capability to generate its own climate modelling inputs to its future NAPs and NCs the following capacities would be required[261]:

- A comprehensive and readily accessible digitized database of ongoing weather and climate observations to World Meteorological Organization (WMO) standards
- Similar databases to fulfil requirements for hydrological parameters
- Appropriately-qualified staff

[260] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.
[261] NAP, Appendix 5

- Computer resources.

6.4.1.3 Other areas of capacity building linked to UNFCCC needs

Now that the State of Palestine has become a party to the UNFCCC, other key areas will need capacity building such as:

- Development of a complete MRV and M&E system (described in more detail in Section 7.1.2)
- Identification, prioritisation and development of NAMAs
- Development of Low Emission Development Strategy (LEDS)
- Negotiation skills training
- Capacities to create and report a BUR.

The State of Palestine is also considering whether it should engage with the Partnership for Market Readiness (PMR) and the Clean Development Mechanism (CDM) and depending on the outcome of these decisions, other specific capacity-building requirements may be identified.

6.4.2 Capacity building and stakeholder engagement already conducted

Preceding sections of this INCR summarise the thematic technical, financial and capacity-building needs. Even under difficult circumstances, the State of Palestine has engaged in capacity-building activities and some work has already been done. The Table 30 below highlights some areas in which capacity building has occurred.

Table 30: Areas of capacity building in the State of Palestine

Area of Capacity Building	Project
Institutional capacity building	A needs assessment has been developed to understand what capacity building is needed for institutions. See Section 6.4.3. Due to this assessment, some work is already in progress.
The strengthening or establishment, as appropriate, of national climate change secretariats or national focal points	A national focal point (NFP) to the UNFCCC has already been identified in the State of Palestine and capacity building opportunities have risen as a result of various meetings, training and capacity building workshops. However, in addition to the NFP, stakeholders who work in climate change within the State of Palestine and abroad have also undertaken capacity building but still require training. The Clima South regional projects, among others, have been a main drive behind capacity building.
Capacity building for implementation of adaptation measures	Prioritisation of adaptation options for the NAP has identified in each case where knowledge and skills within the State of Palestine are lacking and the necessary steps in terms of capacity building required to enable their implementation. Estimated costs of capacity building have been identified for Years 1-5 and 6-10. Further details can be found in the V&A Chapter.
Capacity building for vulnerability and adaptation assessments	The process of developing the NAP was led by an international expert who supported the team of national experts from Palestinian universities and briefed stakeholders at a series of workshops held at key stages in the NAP's development. In turn, the national team facilitated stakeholder input to the vulnerability assessments for each theme or sector and to the identification and prioritisation of adaptation options. The final NAP was then quality assured by the international expert. This emphasis on capacity building means that when the NAP is next updated it should be relatively simple for national experts and stakeholders to review the vulnerability assessment and progress with implementation of the adaptation options. However, quality assurance by an international expert is recommended to ensure adherence to the same process.

Area of Capacity Building	Project
	A consistent approach will enable any change in perceived vulnerabilities to be used as a measure of the success or otherwise of adaptation actions during the intervening period.
Assessment for development of mitigation options	As part of the development of this INCR, two training sessions were provided on the model underlying the mitigation options analysis. Participants and stakeholders in the second course were shown how to create a new mitigation option in the model so they would be able to replicate the work independently in the future.
Development of GHG inventories	As part of the development of this INCR, capacity building and training has been conducted on: • GHG inventories principles and practice, • quality control and data management • use of the 2006 IPCC software • GHG and energy projections (LEAP software).
Improved decision-making, including assistance for participation in international negotiations	From 2009 until 2015, support has been received from UNEP, UNDP, ESCWA and Clima South project of EC to enhance EQA's participation at the COP negotiations. Now that the State of Palestine is a party to the convention, it is expected to receive more support in that regard

Moreover, the State of Palestine is among the partner countries participating in the Clima South Regional Project funded by the EU which supports nine South Mediterranean countries with capacity building to tackle climate-change mitigation and adaptation[262]. As part of this regional effort, Clima South hosted a Palestinian national training seminar on climate change in January 2015, which enabled the Palestinian Government to improve the understanding and management of their climate-change issues. It was structured to raise awareness and train staff on climate actions with the view to making the best use of partner's supports and successfully envisaging medium and long-term strategies to address climate-change impacts in the relevant sectors for the country (primarily water and agriculture). It also facilitated crucial dialogue among relevant stakeholders[263].

Stakeholder engagement is key for activities and knowledge transfer to occur successfully and effectively. As such, stakeholders have been heavily involved in capacity building activities, especially as part of developing every pillar of this INCR. The stakeholders were engaged and involved in the development of all mitigation and adaptation scenarios presented and provided most of the assumptions and data used for the development of the GHGI. Moreover, training and workshops were conducted specifically to engage stakeholders throughout the entire process of the development of this INCR.

Table 31: Training and workshops as part of developing the INCR

Workshop area	Aim	Stakeholders engaged
GHGI and mitigation		
Workshop 1: Inception workshop	Initial introduction to GHG emissions inventories: purpose of the GHGI, what it should focus on and how it can be developed	EQA, Birzeit University, PENRA, MOA, MOPAD, UNDP, PEC, MOLG, MOT, PCBS, MOPAD, …
Workshop 2: Development of GHGI and Mitigation analysis	Training on data collection for the GHGI Introduction to mitigation analysis-relationship between GHGI, baseline / business as usual projections and mitigation	EQA, Birzeit University, PENRA, MOA, MOPAD, UNDP, MOLG, MOT, PCBS, …

[262] For more information: http://www.climasouth.eu
[263] For more information: http://www.climasouth.eu/drupal/en/node/231

Workshop area	Aim	Stakeholders engaged
	scenarios. Initial introduction to LEAP	
Workshop 3: GHG emissions inventory and sector options workshop	QA /QC on GHGI Updating the GHGI Reporting Sector options & GHGI workshop Training on 2006 IPCC software	PCBS, EQA, PENRA, MOT, PWA, MOLG, MOA, MoNE, MOPAD, … Separate sessions with key sectors, Energy (PENRA) Waste (MOLG), Agriculture, (MOA)
Workshop 4: GHGI and Mitigation workshop	Present the GHGI and Mitigation Chapters of Palestine's INCR to the UNFCCC to key stakeholders• National & thematic workshops held with each of the sector ministries	EQA, Birzeit University, PENRA, MOA, MOPAD, UNDP, MOLG, MOT, PCBS, …
Workshop 5: LEAP training	Training using LEAP using the model developed for Palestine	EQA, PCBS, UNDP, MOT, Ministry of National Economy (MONE), MOLG, MOA, …
Vulnerability and adaptation (V&A)		
Workshop 1: V&A Framework	Present, discuss and validate the proposed approach to developing a National Adaptation Plan	UNDP, EQA, Birzeit University, Hebron University, Islamic University of Gaza, MOA, MONE, PWA, Palestinian Meteorological Department, MOPAD, Applied Research Institute, Coastal Municipalities and Water Utility (Gaza), …
Workshop 2: Training Workshop on assessment of vulnerability to climate change	Introduction to the development of the V&A Assessment and the institutional arrangements required	UNDP, EQA, Birzeit University, Hebron University Islamic University of Gaza, MOA, MONE, PWA, Palestinian Meteorological Department, MOPAD, Applied Research Institute, Coastal Municipalities and Water Utility (Gaza), …
Workshop 3: Vulnerability and Adaptation	Agree on prioritization of vulnerabilities across all sectors/themes	UNDP, EQA, Birzeit University, Hebron University Islamic University of Gaza, MOA, MONE, PWA, Palestinian Meteorological Department, MOPAD, Applied Research Institute, Coastal Municipalities and Water Utility (Gaza), ….
Workshop 4: National Adaptation Plan	Workshop to agree prioritisation of adaptation options across all sectors/themes	UNDP, EQA, Birzeit University, Hebron University Islamic University of Gaza, MOA, MONE, PWA, Palestinian Meteorological Department, MOPAD, Applied Research Institute, Coastal Municipalities and Water Utility (Gaza), …
Workshop 5: Launch of the NAP and V&A Chapter of the INCR	Present the National Adaptation Plan and V&A chapter of the INCR to key stakeholders.	UNDP, EQA, Birzeit University, Hebron University Islamic University of Gaza, MOA, MONE, PWA, Palestinian Meteorological

Workshop area	Aim	Stakeholders engaged
		Department, MOPAD, Applied Research Institute, Coastal Municipalities Water Utility (Gaza), ….

6.4.3 Capacity building: governance structure and institutions

In addition to identifying what are the key themes that need capacity building (as shown in Section 6.4.1), it is important to identify the key institutions that need it. In order to do so, the EQA and the UNDP prepared the NCDP. This work was developed with the aim of enhancing the State of Palestine's institutional capacities to mainstream and address the challenges of climate change in the areas of reporting, mitigation and adaptation.

The key government institutions that need to be involved in the capacity building are:

- Environment Quality Authority (EQA) as the lead agency on climate change
- Palestinian Central Bureau of Statistics (PCBS)
- Ministry of Finance and Planning (MOFP)
- Ministry of Agriculture (MOA)
- Palestinian Water Authority (PWA)
- Ministry of Transportation (MOT)
- Palestinian Energy and Natural Resources Authority (PENRA)
- Palestinian Meteorological Department (PMD).

These institutions are constrained by inadequate or non-existent systems and tools and a low level of awareness and competencies on climate change. Under this assignment, the national capacities of those institutions with regard to the short and long-term environmental and climate-change needs were assessed and the priorities of capacity building for them has been identified as:

- Governance structure, institutions, and required capacity development
- Amending the legal and regulatory framework
- Establishing and enhancing climate finance readiness (see Section 7.1.1)
- Establishing and enhancing general awareness, communication, education, research and knowledge management (see Section 6.3)
- Establishing an MRV system for adaptation and mitigation (see Section 7.1.2)
- Coordination and partnerships.

An action plan, including prioritization, responsibilities, and implementations means, has been developed for each of the identified areas for the next five years. The implementation of this capacity-development program needs to be accelerated after accessing the UNFCCC.

The State of Palestine is keen to extend capacity building to other key actors, such as industries, academia, and NGOs across a larger set of themes. Table 32 highlights the additional set of actors and the themes for which the State of Palestine urgently continues to need support for capacity building.

However, it should be mentioned that in addition to the entities presented in the table, most governmental agencies should be targeted by capacity-building activities and schemes, including but not limited to: Ministry of Local Governments, Ministry of Woman Affairs, Ministry of Housing and Public Works, Ministry of Tourism and Antiquities, Ministry of National Economy, Ministry of Health, Ministry of Social Affairs, Ministry of Education and Higher Education, Ministry of Foreign Affairs. Members of the NCCC should also be targeted.

Table 32: Capacity building themes across Palestinian institutions.

Institutions	Climate governance	GHG Inventories	Mitigation	Adaptation	Research & observation	Climate modelling	MRV	Negotiation training
EQA	✓	✓	✓	✓	✓	✓	✓	✓
MoFP	✓	✓	✓	✓			✓	
MoA	✓	✓	✓	✓	✓	✓	✓	
PWA	✓	✓	✓	✓	✓	✓	✓	
MoT	✓	✓	✓	✓			✓	
PENRA	✓	✓	✓	✓			✓	
PMD	✓				✓	✓	✓	
PCBS		✓			✓		✓	
Industries		✓	✓	✓			✓	
Academia				✓	✓	✓		
NGO				✓				

6.5 Information and networking

Information and networking are key to sharing lessons learned and best practices to ensure efficient and effective climate activities. On the regional level, the State of Palestine has engaged in the Arab Climate Resilience Initiative, which supports information exchange between Arab states funded by the UNDP regional bureau for Arab states[264].

The Annexation and Expansion Wall and the blockade of the Gaza Strip has severely worsened Palestinian life (see 1.2). The Wall has reduced the access of Palestinians living in communities located behind the Wall to workplaces and essential services. In order to continue living in their own homes and to maintain family and social relations with the rest of the West Bank, Palestinians must obtain permits or "prior coordination" and pass through checkpoints in the Wall. Access of service providers to these communities, including ambulances and fire brigades, has been impaired[265]. Consequently, the occupation has made information and network sharing on the national level very difficult. Flow of information, cooperation and coordination between staff members that work on climate change in both the West Bank and the Gaza Strip has been jeopardized by the blockade of the Gaza Strip and the lack of possibility to move freely between both areas, in addition to road blocks and Israeli check points throughout the West Bank. Setting up meetings or face-to-face trainings to discuss and plan climate change-related issues are always subject to change and delays due to Israel's control over mobility. This inability to move freely, impacts the ability of information to flow freely as well. This undoubtedly impacts on the quality of final program and project outputs and hinders the true potential for the State of Palestine to tackle climate change effectively.

Despite these difficulties, the State of Palestine has worked hard to institutionalize efforts to promote information sharing. Therefore, it has been planned to create the Climate Change Coordination Department at EQA's General Directorate of Disaster Risk Reduction and Climate Change, which is planned to be created in EQA, as recommended/planned in the NCDP. The Climate Change Coordination Department will be a centralized entity responsible for coordinating the response of multiple state agencies, governorate and local government units and relevant NGOs. Its purpose will be to support local communities in meeting climate change challenges related to emergency responses, impacts and changes in adaptive and resilience practices, as well as related to mitigation actions. The fulfilment of this role will require the development of a process for prioritizing and addressing climate-challenged communities.

[264] For more information: http://www.arabclimateinitiative.org/
[265] OCHA (2013) Humanitarian impact of the barrier. https://www.ochaopt.org/documents/ocha_opt_barrier_factsheet_july_2013_english.pdf

The Climate Change Coordination Department at EQA will have to facilitate the effectiveness of the communications and interactions of government agencies and other relevant entities working on climate change in the State of Palestine. Furthermore, the Department will provide substantial technical assistance, helping relevant working groups and task forces at the community level to organize their responses to climate-change issues. In doing so, it should seek ways to streamline communication, interaction with and among communities and to reduce the burden on the communities[266]. However, this remains a daunting task under occupation.

[266] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.

7 General description of steps taken or envisaged to implement the UNFCCC

It is important to note that the State of Palestine has already demonstrated ambition and drive to tackle climate change and has identified potential next steps. However, this will be difficult to implement as long as the country remains under Israeli occupation. The State of Palestine is a country with very limited financial resources. Therefore, to fulfil all its obligations under the Convention, it will need both full independence, technology transfer, capacity building and financial support.

As next steps, the State of Palestine is focusing to establish and enhance its climate-finance readiness. Moreover, to ensure that the financial support is effectively and wisely used, the Palestinian Government is planning to develop an MRV and M&E systems with suitable indicators. It is also planning to prepare its National Determined Contribution (NDC). These plans need the essential support from the Convention with regard to capacity development, technology transfer and financial support in order to be translated into actions on the ground.

7.1.1 Establishing and enhancing climate-finance readiness

Now that Palestine is a party to the UNFCCC, it has already completed the first next step. It recently selected and nominated EQA to become the Country's National Designated Authority (NDA) to the Green Climate Fund (GCF). In order to access the GCF and fulfil its duties as a NDA to the GCF, EQA will need to establish a number of institutional processes including a 'no objection procedure' and 'coordination mechanism' and will undoubtedly require further capacity building.

The State of Palestine has already started communicating with the GCF and appointed a National Focal Point (NFP) for the NDA and EQA submitted a request for GCF's Readiness Program which UNFCCC parties are eligible to benefit from. Currently, EQA is working on nominating NFPs for the Climate Technology Center and Network (CTCN), Article 6 of the convention - Action for Climate Empowerment (ACE), and NAMAs Facility among others.

The next step will be for the State of Palestine to map access points to the possible funding routes which includes:

- Undertake "donor-mapping" by identifying possible donors for climate change and their potential to support the country
- Assess donors priorities, access criteria, instructions and guidelines, and barriers to funding
- Match against the State of Palestine's climate objectives and priorities
- Identify strategically important funding streams
- Focus on these to attract funding
- Prepare concept notes and project proposals and documents to selected IFIs.
- Enhance the capacities of fundraising,

A comprehensive study on potential climate-change funds was prepared in 2013 by the UNDP and gives a clear road map for potential climate-related windows of funds, which may be considered a good basis to build on. A separate NCDP also identified the option of creating a special national system for a climate fund.

However, an overall national climate-finance and good financial governance structure still needs to be established to lay the foundation for climate-finance readiness in the State of Palestine. This includes the establishment of a national climate-finance architecture and the integration of climate change into the public-finance system, which is important with regard to sourcing the government institutions, as well as to attract further donor funding. Furthermore, a National Climate Fund (NCF), or a National Climate and Environment Fund, needs to be established and operationalized. In particular, the NCF and the sector ministries and agencies, as implementing and executing bodies channelling mainly international climate finance to climate action in the State of Palestine, will need to demonstrate sound fund management, access and blend (climate) funding, and make effective investment decisions.

Financial oversight with regard to auditing and evaluating the proper and efficient use of climate finance will be a key responsibility of the NCF. This is related to the development of effective and transparent

spending and implementation processes, involving the NCF and the sector ministries and agencies. Internal integrity-management systems and internal-control mechanisms of the involved organizations need to be improved.

The national institutions receiving international climate finance through bilateral and multilateral channels will have to have the appropriate administrative and technical capacities in place to access these sources. Different reports of the World Bank and International Monetary Fund clearly stated and acknowledged the readiness of Palestinian Public Financial Management (PPFM) and its high standards. [267]The various funds and programs have specific requirements that need to be fulfilled to access and manage disbursed funding. Information about the international climate-finance landscape needs to be provided to the relevant government stakeholders and the understanding of the specific requirements of individual international funds to be established or improved.

Some key measures are proposed to promote private-sector engagement. In particular, special financial sector regulations have to be designed, implemented and monitored to improve the overall investment environment. The development of green financial products, building on the leadership of national banks in this field, should be furthered among the financial sector institutions in the State of Palestine. EQA should look into the development of products and services to implement sustainable value chains and organize awareness raising campaign among financial institutions on the integration of climate and environment risks in corporate risk management schemes together with the Ministry of Finance"[268]. The private sector's corporate social responsibility should also be targeted to be effectively merged with climate and/or environment-funding mechanisms.

7.1.2 Increase transparency through MRV and M&E

Parties to the UNFCCC have to fulfil a number of reporting requirements. These requirements relate to the development of estimates of their national GHG emissions, GHG mitigation actions and their impacts, implementation of NAPs, as well as climate-finance funds, capacity building and technology transfer received from other parties. Climate-finance funding, capacity building and technology transfer are commonly referred to as "support".

The requirements are generally referred to as MRV and will, in parts, be further refined after the Paris Agreement. Information on adaptation can be provided on a voluntary basis. These UNFCCC reporting requirements serve the purpose of providing transparency about climate-related activities that a country is taking at the international level. Donors of climate finance consider the existence of good quality MRV systems as an indicator of a country's ability to make good use of the finance provided and to track the flows of climate finance effectively.

To fulfil its reporting requirements under the UNFCCC, the State of Palestine is planning to develop an effective and efficient MRV system. It will allow the Palestinian Government to maximise the effectiveness of its mitigation and adaptation actions, receive more international climate finance and gain an overview over climate finance and other types of international support received and ensure its effective use. The four areas for which MRV-systems are relevant are

- GHGI
- Mitigation measures
- Adaptation measures
- Financial support.

The development of M&E in relation to the NAP needs to consider possible options for monitoring, as relevant to each of the highly vulnerable issues, in terms of changes in:

- Their climate sensitivity and/or
- Related adaptive capacity and/or
- Their vulnerability/resilience and/or
- Related direct and indirect impacts that may be attributed to climate change and/or

[267] World Bank (2011) Building the Palestinian State: Sustaining Growth, Institutions, and Service Delivery. http://siteresources.worldbank.org/INTWESTBANKGAZA/Resources/AHLCReportApril2011.pdf
[268] Triple E (2015) Assessment of National Capacities for Implementing Climate Change Adaptation and Mitigation Measures and Development of a National Capacity Development Program for the Palestinian Authority - Capacity Development Program Report.

- Progress with implementation of related adaptation options currently being identified and prioritized
- Funds and expenditure on adaptation.

7.1.3 NDC development

The global climate change agreement agreed in Paris in December 2015 was ground-breaking. It sets a long-term goal for reducing global emissions, and puts in place a clear transparency framework and a regular five-yearly process for reviewing country contributions and raising ambition. A total of 160 Intended NDCs (INDCs) were submitted from 187 countries (including the European Union member states), and covering around 95% of global emissions in 2010 (excluding LULUCF) and 98% of the global population[269]. The INDCs set out the actions planned to take on reducing GHG emissions and adapting to climate change, how this will be financed and how the actions will be tracked.

The challenge now is for the INDCs to become NDCs – specific climate-change action plans as opposed to 'intentions' – and to implement the NDCs. The Paris Agreement invites parties to communicate their first NDC no later than when the Party submits its respective instrument of ratification, accession, or approval of the Paris Agreement. As a party to the UNFCCC, the State of Palestine has already started the preparations on its National Determined Contribution

7.1.4 Climate action roadmap

The State of Palestine has developed a suggested roadmap for climate action to guide the next phase of climate actions tied to recently accessing the UNFCCC and plans reported in this INCR. It has already completed a few key next steps, such as nominating the EQA as the NDA to the GCF and appointed the Chair of EQA as a NFP to the GCF, and applying for the GCF's readiness program under the Convention.

The first set of swift actions and steps that the Palestinian Government envisages handling in the short term are to:

- Revise and update of the mandate and structure of the NCCC to be conducted.
- Make proper legislative amendment to reflect the accession to UNFCCC
- Enhance the capacities of national stakeholders by implementing the NCDP
- Enhance the fund-raising capacities of different stakeholders.
- Ensure the State of Palestine has access to different mechanism related to UNFCCC, including CTCN, NAMA Facility, Article 6 (ACE) among others.
- Strengthen linkages and cooperation with UNDP and UNEP, and other accredited agencies to climate-related funds.

The second set of proposed actions to be handled in parallel (or in the longer term) to the actions above are presented in the Table 33, and are set out in more detailed in previous sections of this INCR.

Table 33: Climate action roadmap for the State of Palestine

Item	Actions
Technical gaps in NCs	
GHGI	• Strengthen the PCBS (inventory agency) and EQA (NFP to UNFCCC). PCBS to act as a hub to collect, process, develop and report GHG inventories on an annual basis • Conduct an intensive training programme on the development of a GHGI system, including detailed use of IPCC guidelines, and the reporting of these data internationally • Develop a legal structure that "encourages" activity data producers and relevant ministries to submit data and information to the PCBS

[269] http://climateactiontracker.org/indcs.html

Item	Actions
	• Explore the potential to develop national emission factors for major GHG sources like energy, waste and industrial processes based on available capacities • Develop and enhance QA/QC procedures
Mitigation assessment	• Expand the expertise base and the knowledge capacity for conducting mitigation analysis through an extensive training programme on LEAP and other tools. • Identification, prioritisation and development of NAMAs • Development of Low Emission Development Strategy (LEDS) • Consideration of whether the State Palestine should engage with the Clean Development Mechanism (CDM) • Appoint a NFP for NAMAs Facility
Vulnerability and adaptation	In relation to individual themes/sectors or adaptation options, follow on work (inclusive of stakeholder consultation) could usefully address: • Development of detailed funding proposals • Sectoral strategies and policies • Planning implementation (including spatial plans where data allows) • Establishing new data requirements for future enhancement of the NAP and monitoring and evaluation (including indicator development) • Developing the State of Palestine's capability to generate its own climate modelling inputs to its future NAPs and NCs • Mainstreaming NAP into national development planning process, starting by NDP 2017-2022.
Biennial Update Report (BUR)	Develop the State of Palestine's first BUR
Institutional setup	• Strengthen and institutionalise the proposed National Institutional Framework for Climate Change (NIFCC) by enhancing inter-ministerial and inter-organizational cooperation. • Develop and strengthen the proposed Climate Center for Excellence • Develop and strengthen the proposed General Directorate of Climate Change and DRR/M, including Climate Change Coordination Department at the EQA
Transfer of technologies	• Map all available opportunities for technology transfer in climate related issues. • Conduct a national needs assessment exercise for climate-related technologies required • Appoint a NFP for CTCN
Public awareness and education	• Implement the "National Strategy for Environmental Awareness and Education 2014" • Integrate climate change concepts in national curricula. • Develop informal education programmes/plans in climate change issues • Develop the proposed website "Climate Change in Palestine" • Appoint a NFP for article 6 of the convention (ACE)
Capacity building	• Develop a detailed plan to undertake capacity building and training as identified in chapter 6.4 • Implement the National Capacity Development Program (NCDP) as soon as appropriate and possible
Financial resources	• Engage in the next steps identified in Section 7.1.1 to establish and enhance climate finance readiness • Map of all available financial resources in climate change and exploring opportunities for resource mobilization

Item	Actions
	• Integrate climate change issues in bilateral and multilateral international cooperation programmes in the State of Palestine • Channel available domestic financial resources into areas of direct connection with climate change • Establish a National Climate Change Fund • Enhance the fund raising capacities
MRV and ME	Develop an integrated MRV and ME system as discussed in Section 7.1.2
Develop NDC	Develop an NDC

Annexes to Chapter 2: GHGI

Annex A: Per capita emissions

Table 34: Per capita emissions of the State of Palestine and neighbouring countries.

Country	Population	Emissions/ Capita (Ton of CO_2 eq.)	Year	Source
Palestine	4,168,860	0.8	2011	Population: PCBS[270] Emissions: Calculated by this GHGI
Egypt	66,137,000	2.9	2000	Population: ESCWA Emissions: Second NCR[271]
Syria	21,533,000	3.7	2005	Population: ESCWA Emissions: by INCR[272]
Lebanon	4,160,000	4.4	2000	Second NCR[273]
Jordan	5,600,000	5.1	2006	Population: Jordanian Government[274] Emissions: Third NCR[275]
Israel	7,308,800	10.7	2007	Second NCR[276]

[270] PCBS. Estimated Population in the Palestinian Territory Mid-Year by Governorate,1997-2016 http://pcbs.gov.ps/Portals/_Rainbow/Documents/gover_e.htm
[271] Egyptian Environmental Affairs Agency (2010). Egypt's Second NCR. http://unfccc.int/resource/docs/natc/egync2.pdf
[272] Ministry of state for Environment Affairs (2009) Syria's INCR. http://unfccc.int/resource/docs/natc/syrnc1add1.pdf
[273] Ministry of Environment (2011) Lebanon's Second NCR. http://unfccc.int/resource/docs/natc/lbnnc2.pdf.
[274] The Hashemite kingdom of Jordan. Population & Growth Rate Estimation, 1999-2010. http://www.dos.gov.jo/sdb/sdb_pop/sdb_pop_e/ehsaat/alsokan/1.pdf.pdf
[275] The Hashemite Kingdom of Jordan (2014) Third NCR. http://unfccc.int/resource/docs/natc/jornc3.pdf
[276] Israel Ministry of Environmental Protection (2010) Israel's Second NCR. http://unfccc.int/resource/docs/natc/isrnc2.pdf

Annex B: Supplementary information about the AFOLU sector

Table 35 below highlights how the climatic regions of the State of Palestine were mapped against the IPPC categories. The total area of the country is 6,257 km^2 and the coastal plain in this table refers to the Gaza Strip.

Table 35: Mapping of climatic region of the State of Palestine

2006 IPCC category	Climatic region of the State of Palestine	Area (km^2)
Forest Land	The Central Highlands Region	24.6
	The Coastal Plain	3.2
	The Eastern Slopes Region	24.6
	The Jordan Valley Region	24.6
	The Semi-Coastal Region	24.6
Crop land	The Central Highlands Region	525.8
	The Coastal Plain	88.0
	The Eastern Slopes Region	86.2
	The Jordan Valley Region	30.4
	The Semi-Coastal Region	201.0
Wetland	The Central Highlands Region	n/a
	The Coastal Plain	0.4
	The Eastern Slopes Region	N/A
	The Jordan Valley Region	N/A
	The Semi-Coastal Region	N/A
Settlements[277]	The Central Highlands Region	139.6
	The Coastal Plain	82.3
	The Eastern Slopes Region	139.6
	The Jordan Valley Region	139.6
	The Semi-Coastal Region	139.6
Grassland	The Eastern Slopes Region	2,824.0
Other		1,521.9
Unallocated[278]		237.0
Total area of the State of Palestine		**6,257.0[279]**

[277] The settlements include Palestinian and illegal Israeli built up land on Palestinian land. The data is for the year 2006.
[278] This amount of land was not included in the GHG inventory calculations
[279] UNEP (2003) Desk study on the environment in the Occupied Palestinian Territories. www.unep.org/download_file.multilingual.asp?FileID=105

Table 36: Stratification of the State of Palestine into climate zones, ecological zones and soil types

Allocation to IPCC categories					
Region	**Topography**	**Climate Domain**	**Climate Region**	**Ecological Zone**	**Soil type**
West Bank (including East Jerusalem)	The Jordan Valley Region	Sub-Tropical	Warm temperate dry	Subtropical dry forest	High Activity Clay Mineral
	The Eastern Slopes Region	Sub-Tropical	Warm temperate dry	Sub-tropical Steppe	High Activity Clay Mineral
	The Central Highlands Region	Sub-Tropical	Cool temperate dry	Subtropical mountain systems	High Activity Clay Mineral
	The Semi-Coastal Region	Sub-Tropical	Cool temperate moist	Subtropical steppe	High Activity Clay Mineral
Gaza Strip	The Coastal Plain	Sub- tropical	Warm temperate moist	Subtropical steppe	Sandy

Annex C: Supplementary information about the solid waste sector

Table 37: Waste arising and percentage disposed to SWDS in the State of Palestine (1980-2013)

Method of calculation	Year	Total MSW (Gg)	% to SWDS [280]
UN Population data multiplied by default factor at 0.21 (tonnes/capita/year)	1980	286.085	90
	1981	295.52	90
	1982	304.955	90
	1983	314.39	90
	1984	323.825	90
	1985	333.26	90
	1986	345.462	90
	1987	357.663	90
	1988	369.864	90
	1989	382.065	90
	1990	394.266	90
	1991	413.857	90
	1992	433.447	90
	1993	453.037	90
	1994	472.627	90
	1995	492.217	90
	1996	509.75	90
	1997	527.283	90
	1998	544.048	90
	1999	561.224	90
	2000	578.485	90
	2001	594.615	90
	2002	611.049	90
	2003	627.967	90
	2004	645.57	90
	2005	664.65	90
	2006	632.68	90
Activity data on national waste generation and waste composition was collected and processed	2007	697.45	90
	2008	770.76	90
	2009	837.6	90
	2010	889.3	90
	2011	970.68	90
	2012	1066.02	100
	2013	1153.95	100

[280] Solid-waste-disposal sites

Table 38: Breakdown of composition of waste going into solid disposal sites in the State of Palestine[281]

Waste	Percentage (%)
Food	31.8
Garden	7.6
Paper	10.5
Wood	0.8
Textile	6.4
Nappies	9.9
Plastic (Other inert)	33

[281] This composition was assumed to be the same from 1980-2013

Annexes to Chapter 3: GHG mitigation assessment

Annex D: Analysis of measures to reduce emissions

Options for reducing emissions fall into several broad categories:

- Options to use less energy (energy efficiency in for example buildings or transport)
- Options to use less polluting energy (e.g. renewables, or natural gas substituted for coal, or waste for energy)
- Options to capture emissions
- Options to replace particular polluting gases with other, less or non-polluting gases
- Changes to land use and agricultural practice.

Many of these have significant potential in the State of Palestine but face barriers because of the country's occupation by Israel.

Energy-efficiency measures are the first choice, but their deployment in the State of Palestine is hindered by the administrative difficulties in the region. Enforcement of energy-efficiency standards, such as building-construction standards, which already exist, is difficult. In some cases, those standards are not within the control of the State of Palestine, such as vehicle standards, which are set more globally for EU or US markets. The choice facing the State of Palestine here is essentially whether or not to subscribe to a global standard. Localization of international standards could be an attractive approach (for example, adoption of standards on car efficiency).

Turning now to using less polluting energy, the State of Palestine has excellent renewable energy resources in the form of solar and to a lesser extent wind energy. In common with countries across the Middle East, solar PV in particular is now competitive with grid electricity, and in many cases cheaper. The further advantages of locally-produced electricity which does not rely on imported fossil fuel are obvious. Rooftop PV may be a natural extension from the widespread use of solar water heaters in the State of Palestine. However, the use of PV beyond rooftops – ground mounted installations – is likely to be less attractive. In the Gaza Strip, the simple fact of high population density and, therefore, high demand for land, means that dedicating large land areas for PV is likely to be unattractive. On the other hand, once the State of Palestine has full control of land resources, the Jordan Valley is promising with its very high solar energy levels. This aside, the potential for PV is very large. As a rough estimate, coverage of 1% of the surface area of the West Bank with PV would be enough to supply the country's entire projected electricity demand in 2040[282].

Other renewable energy options such as wind, wave, geothermal and biomass have been investigated, but their potential is limited compared to PV. The potential of PV in the Arab world was set out in the "Pan-Arab Renewable Energy Strategy 2030" by the International Renewable Energy Agency (IRENA) and the League of Arab States[283]. This shows that the State of Palestine already has a relatively ambitious target for 2020 of 10% of electricity from renewables.

Increasing the use of clean electricity is also possible. As far as electric vehicles are concerned, there are already a small number of HEVs in the State of Palestine, and with the relatively small size of the country and so relatively short journeys, this could be an attractive option in the longer term. There are also tax incentives for electric vehicles and hybrids, as shown in Table 39. However, at present there are a number of factors weighing against electric vehicles in the State of Palestine. The first of these is the cost; there is a significant premium to diesel or gasoline vehicles at present. The second is that the electricity supply is not yet fully reliable. Significant uptake of electric vehicles might also require some strengthening of the electricity network. Electric vehicles are too costly at present and the limited means of providing the subsidy that would be needed, means that this is not likely to be attractive for the State

[282] 20% load factor, 12m2 per kWp, demand in 2040 is c. 8 billion kWh/ year, area of West Bank is around 5,000 km2
[283] International Renewable Energy Agency (IRENA) (2014) Pan-Arab Renewable Energy strategy 2030: roadmap of actions for implementation, 2014. http://www.irena.org/DocumentDownloads/Publications/IRENA_Pan-Arab_Strategy_June%202014.pdf

of Palestine in the near term in the BAU 'status quo' pathway. However, under the BAU 'independence' pathway, electric vehicles, including HEVs, could be a worthwhile option and are explored later.

Table 39: Vehicle import tax rates[284]

Vehicle type	Tax rate
Standard vehicles above 2,000cc	75%
2,000cc and below	50%
Hybrid vehicles	30%
Electric vehicles	10%

Use of natural gas for vehicles is also possible, particularly for goods and public transport vehicles. This can have a number of air quality benefits. However, it requires refuelling infrastructure.

Capturing emissions has been discounted because of the early stage of the technology, and uncertainties about the suitability of the geological conditions in the State of Palestine.

As far as high-GWP gases are concerned, as noted in the GHGI chapter, the country's emissions of these gases are not measured but assumed to be negligible.

Waste is a major issue in the State of Palestine; particularly uncontrolled dumping and burning. The use of waste for fuel or for electricity generation (gasification), particularly in the future cement industry, is an option that would have many additional benefits beyond GHG emission reduction from waste.

Finally, agriculture and land use, although important to the State of Palestine, represent relatively small proportions of the emissions, and information on land-use change is not available. However, there are a number of measures being used or considered in neighbouring countries, such as manure management, which might be appropriate for the State of Palestine.

A summary of the options is in Table 40 below.

Table 40: Mitigation options considered

Sector	Option	Description
Power	Solar PV	Can be used on buildings, and for remote power requirements e.g. water pumping units Already in development e.g. currently the Dead Sea Photovoltaic Generating Plant is 710 kW and is planned to be 1.5 MW
Buildings	Building energy efficiency	Insulation, shading of windows, air flow optimization, white roofs, efficient lighting – beyond current building standards
	Lighting efficiency (efficient lighting)	Use of energy saving lamp bulbs
Waste	Energy-from-waste for electricity production	
	Energy-from-waste for cement	

[284] Source provided by Ministry of Transport

Sector	Option	Description
	Reduction in CH_4 from landfill	It is assumed[285] that it would be possible for 20% of methane at landfills to be captured, corresponding to around 76 million m³ of methane emissions.
Transport	Use of natural gas	Used elsewhere for goods vehicles in particular. Can be economic without subsidy. Previously considered by Ministry of Transport Would need an amendment to the Traffic Act to include these types of vehicles in terms of license fees
	Hybrid electric vehicles	Substitution of existing gasoline/ diesel vehicles with hybrid electric vehicles
	Transport modal shift	Reducing travel by private car and increasing travel by bus
Agriculture and forestry	Afforestation	Expanding the State of Palestine's existing forests

In order to decide what options to pursue, they were assessed for cost-effectiveness, feasibility and wider benefits (abatement cost). Feasibility in particular would be different under the BAU 'independence' pathway as compared to the BAU 'status quo' pathway, so the options were considered separately.

Table 41: Assessment of mitigation options for Palestine: wider benefits

Option	Wider Benefits
Solar PV	Energy security Air quality
Building energy efficiency	Reduced energy consumption and increased energy security Greater building comfort
Lighting efficiency	Energy security, reduced need for electricity network upgrades, lower energy bills, lower electricity demand at times of low PV output (i.e. dusk/darkness)
Energy from waste for electricity production	Reduction in waste, increased energy security
Energy from waste for cement	Reduction in waste
Reduction of methane from landfill	Increased energy security
Use of natural gas in taxis	Improved air quality
Hybrid electric vehicles	Air quality, reduced imports of fossil fuel
Transport modal shift	Reduced traffic congestion, improved air quality

[285] ARCADIS, IEEP, ERM, Metroeconomica, Ecologic, Ecologic Institute, Palestine Wildlife Society (2011) Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection. http://www.enpi-info.eu/library/sites/default/files/attachments/OPT-ENPI%20Benefit%20Assessment.pdf

Option	Wider Benefits
Afforestation	Social/recreational benefits

Abatement costs were calculated using the United Nations Environment Programme (UNEP) GHG Abatement Cost Model (GACMO) unless otherwise stated. Fuel and electricity prices for the State of Palestine were used. The discount rate was conservatively assumed to be 12%, which is at the upper end of that assumed by the World Bank and others for developing countries[286].

Even with a discount rate of 12%, which is high, some of the options are cost-effective. This is a common finding globally; efficiency measures, and increasingly renewable energy, can reduce emissions at a low cost and in some cases bringing net financial savings. However, uptake can be limited without other barriers to uptake being addressed. For example, the Palestinian Energy and Natural Resources Authority (PENRA), as part of the Palestinian Solar Initiative, identified a number of barriers to PV in the State of Palestine. Analysis is already underway on RE sources and potential, and the general law on renewable energy has been ratified. Therefore, the barriers to focus on are around enabling financing mechanism, professional skills, laboratory accreditation and quantifying externalities. This has guided the choice of solar PV project proposed in the main text.

A key barrier in the State of Palestine is the occupation by Israel. This will affect the feasibility of every option to some degree, but some options more than others. An assessment of feasibility in the BAU 'status quo' and BAU 'independence' pathways is shown in Table 42 below.

Table 42: Feasibility of mitigation options, by pathway

Option	Feasible under BAU 'status quo' pathway?	Feasible under BAU 'independence' pathway?
Solar PV	Yes	Yes
Building energy efficiency	Potentially – current difficulties with enforcement likely to continue	Yes
Lighting efficiency	Yes	Yes
Energy from waste for cement	Yes	Yes
Energy from waste for electricity generation in general	Yes	Yes
Reduction of methane from landfill	Yes	Yes
Electric/ hybrid vehicles	Potentially, but difficult	Yes
Transport modal shift (increased use of buses)	To some extent	Yes
Converting taxis to natural gas	Yes	Yes
Afforestation	Yes	Yes

By combining the calculated figures for potential with the figures for abatement cost, an assessment of total cost can be made, as shown in Table 43 below. It should be noted here that even if the abatement

[286] Zhuang, et al. (2007) Theory and Practice in the choice of social discount rate for cost-benefit analysis: a survey. Asian Development Bank, 2007. Available at: http://www.adb.org/sites/default/files/publication/28360/wp094.pdf

cost indicates that it is not a realistic option, other co-benefits associated with these actions should be considered, i.e on air quality, adaptation co-benefits etc.

Table 43: Cost of mitigation options

Option	Cost per tonne CO_2e (US$)	Potential (tonnes CO_2e per year)	Cost per year	Realistic actions?
Solar PV	-13.03	2,900,000	-37,776,018	yes
Building energy efficiency	-10.00	510,000	-5,100,000	yes
Lighting efficiency (efficient lighting)	26.61	334,000	8,886,671	
Energy from waste for electricity production	26.85	3,000	80,542	
Energy from waste for cement	0*	110,000	-	yes
Reduction in methane from landfill	-43.45	290,000	-12,601,434	yes
Use of natural gas in vehicles	207.51	42,500	8,819,256	
Hybrid electric vehicles	248.31[287]	39,000	9,684,188	
Transport modal shift	45.89	145,000	6,654,735	
Afforestation	16.78	9,000	151,021	
TOTAL COST REALISTIC				-55,477,453
TOTAL COST ALL OPTIONS				-21,201,039

*Assumed that waste costs the same as coal

[287] Assumes conversion of standard private cars