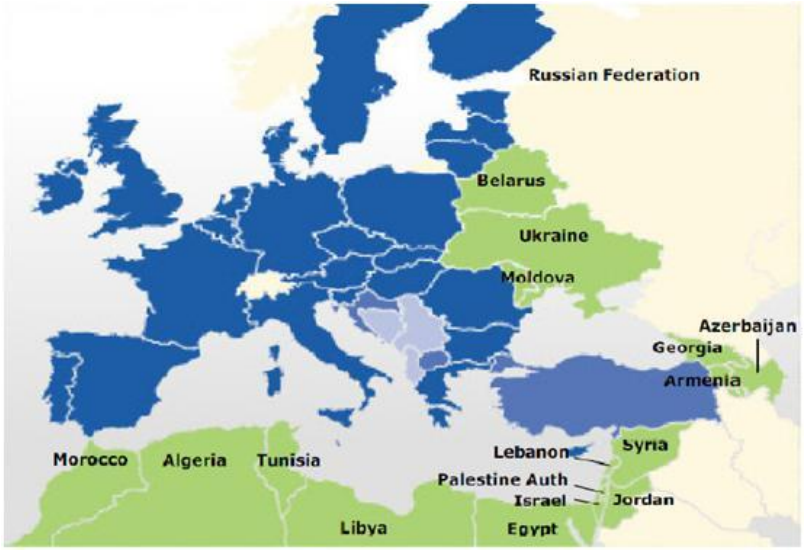
ANALYSIS FOR EUROPEAN NEIGHBOURHOOD POLICY (ENP) COUNTRIES AND THE RUSSIAN FEDERATION ON SOCIAL AND ECONOMIC BENEFITS OF ENHANCED ENVIRONMENTAL PROTECTION

REGIONAL SYNTHESIS REPORT: ENPI South

Synthesis report on: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, occupied Palestinian territory, Syria and Tunisia



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ACRONYMS

AQ ..... Air quality
BA ..... Benefit Assessment
BAM..... Benefit Assessment Manual
BAP ..... Biodiversity Action Plan
BAT ..... Best Available Technique
BAU ..... Business as usual
BCM..... Billions of Cubic Meters per annum
BFT ..... Benefit Function Transfer
BOD ..... Biological oxygen demand
C&D ..... Construction and demolition
CBD..... Convention of Biological Diversity
CE ..... Choice Experiment
CH_4..... Methane
CO..... Carbon monoxide
CO_2 eq. ..... CO_2 equivalent
CO_2 ..... Carbon Dioxide
COD ..... Chemical oxygen demand
COED ..... Cost of Environmental Degradation
COI..... Cost of Illness
CV ..... Contingent Valuation
DALYs ..... Disability Adjusted Life Years
DC..... Dichotomous Choice
DCCV ..... Dichotomous Choice Contingent Valuation
DRF ..... Dose Response Function
E. coli ..... Escherichia Coli
EC ..... European Commission
EE..... Energy efficiency
EEA ..... European Environmental Agency
EIA ..... Environmental Impact Assessment
ENP ..... European Neighbourhood Policy
ENPI ..... European Neighbourhood and Partnership Instrument
EPA ..... US Environmental Protection Agency
EU ..... European Union
FAO..... United Nations Food and Agricultural Organisation
GAR ..... Ground Water Recharge
GDP ..... Gross Domestic Product
GEF ..... Global Environment Facility
GES ..... Good Ecological Status
GHG ..... Greenhouse gasses
GLASOD ..... Global Assessment of Soil Degradation
GW ..... Ground Water
HCA..... Human Capital Approach
HCV..... Human Capital Value
Hg ..... Mercury
IBA ..... Important Bird Areas
IPA ..... Impact Pathway Approach
IPCC ..... Intergovernmental Panel on Climate Change
IUCN ..... International Union for Conservation of Nature
JMP..... Joint Monitoring Program

LCU ..... Local Currency Unit
MDG ..... Millennium Development Goals
MEA..... Multilateral Environmental Agreements
MICS ..... United Nations Multiple Indicator Cluster Survey
MOE ..... Ministry of Environment
MOWI..... Ministry of Water and Irrigation
MSA ..... Mean Species Abundance
MSW..... Municipal Solid Waste
NGO..... Non-Governmental Organisation
NH_3 ..... Ammonia
NMVOCs..... Non-Methane Volatile Organic Compounds
NO_X ..... Nitrogen Oxides
NPV..... Net Present Value
O&M..... Operations and Maintenance
O_3..... Ozone
OECD ..... Organisation for Economic Cooperation and Development
OPT..... Occupied Palestinian Territory
PA ..... Protected Area
PAH..... polycyclic aromatic hydrocarbons
Pb ..... Lead
PE ..... Population Equivalent
PM ..... Particulate Matter
PPP ..... Purchasing Power Parity
RES ..... Renewable Energy Source
S..... Sulphur
SEA ..... Strategic Environmental Assessment
SEBI ..... Streamlining European Biodiversity Indicators
SO_2 ..... Sulphur Dioxide
SO_X..... Sulphur Oxides
SW ..... Surface Water
SWAR..... Surface Water Runoff
SWQS..... Surface Water Quality Standards
TARWR ..... Total Actual Renewable Water Resource
TEEB..... The Economics of Ecosystems and Biodiversity
TEV ..... Total economic value
TOE..... Tons oil equivalent
TPES..... Total Primary Energy Supply
UN ..... United Nations
USD..... United States Dollar
VOCs..... Volatile Organic Compounds
VOLY..... Value Of Life Years
VPF ..... Value of prevented Fatality
VSL..... Value of Statistical Life
WASH ..... Water Supply Sanitation and Hygiene
WDPA ..... World Database of Protected Areas
WEI ..... Water Exploitation Index
WFD..... European Water Framework Directive
WHO..... World Health Organisation
WTP..... Willingness to Pay
WWT ..... Waste Water Treatment

1 INTRODUCTION

1.1 This report

This regional synthesis report has been prepared within the project '*Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection*', initiated and supported by the European Commission's EuropeAid. This synthesis report was developed by the Institute for European Environmental Policy (IEEP), together with ARCADIS Belgium N.V. (project leader), Ecologic Institute, Environmental Resources Management Ltd (ERM), Metroeconomica Ltd and several independent experts. This report was fine-tuned in light of discussions at the regional workshop held on 28th and 29th of June 2011 in Brussels, Belgium.

The project covers the 17 partner countries: the 16 countries covered by the European Neighbourhood Policy (ENP) and the Russian Federation (see Figure 1.1 and box 1.1): **Algeria, Egypt, Israel, Jordan, Lebanon, Libya[1], Morocco, occupied Palestinian territory (OPT), Syria and Tunisia (hereafter referred to as 'ENPI South' or as 'Southern partner countries)** and Armenia, Azerbaijan, Belarus, Georgia, Moldova, Russian Federation[2] and Ukraine (hereafter referred to as 'ENPI East').

Under the project, a specific country benefit assessment has been conducted for each of the countries by a team consisting of an EU expert and a national expert, using a Benefit Assessment Manual developed under this project. This Benefit Assessment Manual, which was originally for internal use, has been turned into a Benefit Assessment Manual for policy makers and experts for wider dissemination and provides an understanding of the methodologies applied for the country benefit assessments.

This is the synthesis report for the **ENPI South countries**. It builds on the country benefit assessments by: Abdelkader Baouendi (consultant), Benjamin Gorlach (Ecologic), Clive David Lipchin (Arava Institute for Environmental Studies), Essam Nada (RAED), Fadi Doumani (consultant), Hanadi Musharrafiyeh (consultant), Imad Atrash (Palestine Wildlife Society), Lana Zu'bi (Eco Consult), Mike Van Acoleyen (Arcadis), Mohamed Belhaj Soulami (Clean Tech), Mourad Khaladi (consultant), Samuela Bassi (IEEP), Wim Van Breusegem (Arcadis), Yahia Awaidah (Consultants for Sustainable Development).

All project results, including the 16 country benefit assessment reports, the regional synthesis reports for ENPI South and East, and the Benefit Assessment Manual, are planned to be published on the project website www.environment-benefits.eu and to become available upon request, from the European Commission's EuropeAid, DEVCO F3, Regional Programmes Neighbourhood East.

[1] After some initial work, the benefit assessment for Libya had to be stopped due to the political situation.

[2] The Russian Federation is not formally part of the European Neighbourhood Policy, but holds a 'Strategic Partnership' with the EU. The ENPI financial instrument provides assistance to both the ENP countries and the Russian Federation.

The overall aim of the project is to raise awareness of the value of the environment and ensure that the environment has its due place on the agendas of each government. Its specific objectives are to improve awareness of the benefits of enhanced environmental protections within the ENPI countries and of their capacity to assess these benefits. In this way, the study is meant to support countries integrate environmental considerations into policy making and to mobilise financial resources for environmental improvements.

Figure 1.1 Countries in the ENP and strategic partnership (Russian Federation)

Source: European Commission http://ec.europa.eu/world/enp/partners/index_en.htm

Box 1.1 The European Neighbourhood Policy (ENP)

The European Neighbourhood Policy (ENP) was initiated in 2004, with the objective of strengthening the prosperity, stability and security of the EU and its neighbours. It consists of bilateral policies between the EU and 16 partner countries: Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Israel, Jordan, Lebanon, Libya, Moldova, Morocco, the occupied Palestinian territory, Syria, Tunisia and Ukraine. A strategic agreement was also signed with Russia – the Strategic Partnership with the Russian Federation.

From 1 January 2007 the European Neighbourhood Policy and Strategic Partnership with the Russian Federation have been financed through a single instrument - the European Neighbourhood and Partnership Instrument (ENPI), which was designed to target sustainable development and approximation to EU policies and standards. In May 2011 the two joint Communications: '*A partnership for democracy and shared prosperity with the Southern Mediterranean*' and '*A new response to a changing Neighbourhood*' (EC, 2011a,b) were published, with a renewed commitment to cooperation with the states in the ENPI region. The aim was to strengthen individual and regional relationships between the EU and the ENP countries by making additional funds available in exchange for more mutual accountability. Sustainable development –and environment - was one of the areas in which there was a strong commitment to make progress, as shown for example by the following extracts:

- The EU will join up efforts with its neighbours on **climate change** by enhanced co-operation to address low-carbon development and improve resilience to climate impacts (**adaptation**), The EU and partner countries should also pursue a higher level of the development of new partnerships on **renewable energy sourc**es and **energy efficiency**, and nuclear safety.
- Extending the Energy Community Treaty to neighbours not yet party to it or, building on its

Box 1.1 The European Neighbourhood Policy (ENP)

experience, establishing a complementary 'EU-Southern Mediterranean Energy Community' aimed at enforcing higher standards of **air** and **water quality**, improved environmental **governance**, higher **resource efficiency**, protection of **biodiversity and ecosystems** and supporting the necessary **infrastructure investments**.

- To support sustainable development, implementation of existing regional agreements such as the Barcelona Convention for the Protection of the Marine Environment and Coastal Region of the Mediterranean should be given greater priority.

This benefit assessment aims to offer an evidence base to support the on-going dialogues and cooperation.

1.2 What are assessments of benefits of environmental protection?

An assessment of socio-economic benefits of environmental protection examines the potential positive outcomes for society that result from the adoption of environmental protection targets and the implementation of actions[3] to meet these targets. Such actions may include environmental policies, legislation and investments undertaken by government, industry or other stakeholders, who lead to environmental improvements (e.g. improved water quality from the construction of water treatment plans, reduced air emissions from better regulated industry and transport and so on).

Benefit assessments have played an important role in raising awareness of environmental problems, identifying possible solutions, highlighting the benefits of action and stimulating policy attention, focus and action. They have been undertaken in the context of EU enlargement[4], for cities and infrastructure investments[5] and more recently to emphasise the need to reduce biodiversity loss, invest in natural capital and to galvanise support for action[6].

The environmental benefit assessments undertaken under this project focused on identifying and analysing the potential benefits arising from the achievement of specific environmental protection targets identified for five thematic areas: Air, Water, Waste, Nature and Climate Change.

3 It is therefore not a cost-benefit analysis. The study does not cover the costs of action.

4 Ecotec (2001) *The Benefits of Compliance with the Environmental Acquis for the Candidate Countries*; Ecolas and IEEP (2005) *The benefits for Croatia of Compliance with the Environmental Acquis*; Arcadis-Ecolas, IEEP, Metroeconomica, Enviro-L (2007) *Benefits for fYRoM and other countries of SEE of compliance with the environmental acquis*

5 See e.g., GHK, IEEP, Ecolas, Cambridge Econometric (2006): *Strategic Evaluation on Environment & Risk Prevention under Structural & Cohesion Funds for 2007-2013* - A report for DG Regio

6 *The Economics of Ecosystems and Biodiversity (TEEB)* see www.teebweb.org as well as TEEB 2008, 2009, 2010, 2011.

The analysis involved the following:

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

The methodology applied for the country benefit assessments was developed under the project, building on previous analyses and methodologies, in particular on IEEP's ENP methodology (ten Brink and Bassi, 2007) and the World Bank's Cost of Environmental Degradation (COD) reports.

The methodology is described in a Benefit Assessment Manual for internal use by the project experts that contributed to the country benefit assessments. On the basis of this Manual, a Benefit Assessment Manual has been developed for a wide audience of policy makers in the ENPI countries.[7] This Benefit Assessment Manual provides an in-depth understanding of the methodologies applied under the project and is planned to be published on the project website www.environment-benefits.eu and to become available upon request, from the European Commission's EuropeAid, DEVCO F3, Regional Programmes Neighbourhood East, for organisations which may wish to explore further the benefits of improvement environment and/or carry out their own, more specific or detailed benefit assessments.

1.3 Aims of the benefit assessments

The benefit assessments that have been conducted under this project, intend to help the countries to evaluate the benefits of addressing environmental challenges it is facing and, where possible and appropriate, estimate their economic value – hence making benefits comparable and understandable to a wide audience.

The assessments provide 'order of magnitude' results, in order to communicate the scale and significance of the potential benefits to human health and well-being of reducing pollution, improving environmental quality, giving greater access to environmental infrastructure and of maintaining and/or investing in natural capital stock.

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

The benefit assessment reports aim to assist policymakers that are making a case for implementing and funding environmental policy actions and for environmental policy integration[8]. Environmental policy integration can help to avoid costs to the government and citizens, improving well-being and create growth and jobs, address a range of other key priorities – such as water security, food security, and provision of key environmental infrastructures. The reports aim to assist policymakers by providing new evidence and values on:

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

The evidence base also helps in supporting those promoting action to achieve national and global objectives and targets – such as global commitments like the Convention of Biological Diversity (CBD) COP10 in Nagoya[9]; commitments to the Millennium Development Goals (MDGs) made at the WSSD meeting in Johannesburg and commitments under a range of Multi-lateral environmental agreements (MEAs).

Box 1.2 presents some examples of international key targets; for a wider discussion of targets see section 2.4 and the thematic chapters.

Box 1.2 National Commitments in a Global Context – examples Millennium Development Goals (MDGs) and CBD Strategic Plan 2011-2020

MDG Goal 7 - **Ensure environmental sustainability** - is specifically focused on environmental sustainability. Sub-targets of relevance to the existing study include:

- Target 7A: Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources;
- Target 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss;
- Target 7C: Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation (for more information see the entry on water supply).

The CBD Strategic Plan 2011–2020, includes 5 strategic goals and 20 targets. While all 20 are of relevance (see chapter 8), some key examples are presented below.

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

[9] The CBD Strategic Plan 2011-2020 includes 20 targets which include a range of targets of relevant to nature (biodiversity, forestry, degradation) – see chapter 8 of this report as well as ten Brink et al 2011 in TEEB 2011 and the CBD website.

Box 1.2 National Commitments in a Global Context – examples Millennium Development Goals (MDGs) and CBD Strategic Plan 2011-2020

Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

Target 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

Target 8: By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Source: CBD (2010)

The benefit assessment reports can play an important role in raising awareness regarding environmental problems, impacts and the benefits of action, by communicating these benefits and by making them explicit.

The latter is crucial, as policy makers have often a clearer perception of what it costs to maintain the quality of the environment, than of the resulting benefits. As such the reports can stimulate policy attention, focus, action and appropriate funding.

1.4 Who can benefit from the benefit assessments?

The results of the benefit assessments have the potential to be of value to a wide set of organisations – see Table 1.1 below.

Table 1.1 Organisations that can make use of benefit assessments

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

1.5 Structure of the report

This report focuses on benefits in the ENPI South area. Benefits in the area of air are discussed in chapter 3, water supply and treatment in chapter 4, surface water quality in chapter 5, waste in chapter 6; chapter 7 on nature, and 8 on climate change. The methodology used is presented in detail in the Benefit Assessment Manual and in the country reports. A brief overview of the methodology is also provided in Chapter 2 below.

2 METHODOLOGY SUMMARY

This chapter introduces the methodological framework used under this project (see the Benefit Assessment Manual (BAM) for details) to identify the benefits of improving environmental conditions in the ENPI countries.

2.1 The benefits of an improved environment

The benefit assessments that have been conducted under this project focus on four categories of benefits from environmental improvements:

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

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

- **Environmental benefits**: the uptake of environmental targets and actions clearly brings a direct benefit to natural assets. It should be noted that 'environmental benefits' are here considered distinct from the 'environmental improvements' the benefits stem from. In the BAM, environmental improvements are considered changes in the parameters related to the achievement of certain targets.

  For example, if the target of secondary treatment of all urban waste water would be reached, this would result in environmental benefits, such as improved surface water quality and avoidance of eutrophication, which can lead to biodiversity loss.

- **Social benefits:** benefits to individuals and society at large, including for example:
  - the safeguarding of, and access to, the natural and cultural heritage (e.g., through avoided pollution damage to historic buildings or the destruction of historic landscapes);
  - the safeguarding of the viability of (rural and coastal) communities and employment/livelihoods (e.g. in forest management, agriculture, fisheries, nature based tourism);
  - the enhancement of recreational opportunities (e.g., fishing and bathing),
  - increasing trust in quality environmental service provision (e.g., water quality);
  - improved social cohesion due to support for employment, social learning and the development of civil society (due to increased information provision, consultation and involvement);
  - poverty reduction and improved equality, tackling of rural-urban migration, and other (sustainable) development issues**.**

Specific examples of benefits associated with each area under analysis are presented in the benefit assessment manual (BAM) and in the latter chapters of this report.

The assessment of benefits includes elements which are related to the concept of ecosystem services i.e. the benefits that people obtain from biodiversity (ecosystems, species, and genes). Some of these services provide tangible goods (e.g. provisioning food or fibre); others provide non-market services such as regulating climate, opportunities for recreation, or supporting local cultural identity. Enhancing environmental protection will increase the capacity of ecosystems to provide such benefits (TEEB 2010, TEEB 2011) and therefore, these should also be taken into account in the analysis when relevant. Ecosystem services are grouped using a slightly different classification than the one used in this study. For clarity, in the box below we provide a brief overview of how ecosystem services are classified and how they relate to the approach adopted under this project and explained in the BAM.

Box 2.1 The theory of ecosystem services in relation to the benefit assessment method

Ecosystem services are the benefits that people obtain from ecosystems. According to the widely used classification developed by the Millennium Ecosystem Assessment (2005) and taken up in TEEB (TEEB 2010, TEEB 2011), these services can be categorised as follows:

- Provisioning services such as food, fibre, fuel, water and genetic materials.
- Regulating services i.e. benefits obtained from ecosystem processes that regulate our natural environment such as the regulation of climate, floods, disease, waste and water quality.
- Cultural services such as recreation, aesthetic enjoyment, tourism as well as cultural identity.
- Supporting services i.e. services that are necessary for the production of all other ecosystem services such as soil formation, photosynthesis, and nutrient cycling.

Although the BA encompasses more than the benefits from ecosystems, it is useful to clarify how the benefits from ecosystems - the ecosystem services - can be included in the study. The table below show a simplified categorisation of ecosystem services according to the BA's four benefit types

Table 2.1 Link between the BA benefits and MEA ecosystem services

BA benefits	Services Derived from the Millennium Ecosystem Assessment
Economic benefits	Provisioning services (with no commercial value) – e.g. non-timber forest products, water provision Regulating services (excluding disease regulation) – e.g. climate regulation Supporting services (avoiding double counting with other services)
Social benefits	Regulating services: disease regulation; water and waste regulation
Health benefits	Provisioning services (with commercial value) e.g. fisheries production; cultural services such as tourism; avoided costs of natural hazard management, avoided costs of water purification.
Environmental benefits	Cultural services, e.g. recreation; cultural identity

For a wider discussion of Ecosystem services and their value see TEEB (2008; 2009; 2010; 2011)

2.2 Scope of the assessments: environmental issues under analysis

The improvement of environmental conditions encompasses a vast range of environmental areas and policies. Clearly not everything could be covered by the project.

Given the large number of countries that were assessed under this project, a pragmatic approach was followed by focusing only on selected big issues, choosing a mix of environmental problems that were common across the regions, as well as country specific ones. The selection of issues (parameters) was guided by the need to identify issues of general importance which were sufficiently representative of the five environmental areas and simple enough to be assessed within the project. Other issues, beyond those included here, are clearly also important for some countries. Environmental related topics such as chemicals, nuclear waste, energy efficiency, desertification, mineral/fossil resources, marine fish stocks, and other country specific issues that could not be covered in this work could usefully be taken into account in future country benefit assessments.

It should be noted also that there are methodological limitations as to what can be assessed (e.g. at monetary level) given that many benefits are site specific[10].

The key environmental issues on which the analysis focused cover the five 'themes' - Air, Water, Waste, Nature and Climate Change (as a horizontal area).

For each theme there are also *sub-themes* (e.g. water - water infrastructure and water as a natural resource) identified and, for each sub-theme, smaller categories called '*parameters*' (e.g. connection to safe drinking water). The parameters are the 'smallest units' of the analysis, and the benefit assessment has been levelled at the parameter level.

An overview of the themes, subthemes and parameters is provided in Table 2.2 below. (See BAM for the rationale for the choice).

10 For example natural capital's benefits for water purification, water provision and flood control are very site specific. Benefits transfer assessments need to be done with care and with sufficient data.

Table 2.2 Overview of themes, sub-themes and parameters[11]

THEME	SUB-THEME	PARAMETERS
AIR	Air quality	1. Ambient air quality
WATER	Water - infrastructure and practice	2. Connection to safe drinking water
		3. Connection to sewage network and hygiene conditions
		4. Level of waste water treatment
	Water - natural resources	5. Surface water quality
		6. Water resource scarcity
WASTE	Waste collection	7. Waste collection coverage
	Waste treatment	8. Waste treatment
		9. Methane emissions from waste
NATURE	Biodiversity	10. Level of biodiversity protection
	Sustainable use of natural resources	11. Deforestation levels
		12. Level of cropland degradation
		13. Level of rangeland degradation[12]
CLIMATE CHANGE	Climate change drivers	Deforestation (covered under nature)
		Methane emission from waste (covered under waste)
	Climate change responses	14. Uptake of renewable energy sources
		15. Climate change adaptation (consider responses to 2-3 impacts among: sea level rise; sea temperature rise; desertification; water resource scarcity (covered under water);increased risk of pest or disease outbreaks; risk of forest fire; risk of flood; other effects

[11] Ecosystem services have been addressed within different parameters, and while there is an explicit discussion in chapter 7, the analysis is spread across chapters. Cultural services – recreation and tourism is covered under Biodiversity and Surface water quality); Carbon sequestration and storage is covered under Sustainable use of natural resources – on halting deforestation; and water provision and purification is covered under Water, and via case examples)

[12] Rangeland degradation was not covered in the country reports, since FAO data suggest that potential cost of rangeland degradation, and potential benefit of improvement, may be significant only in 4 out of the 16 countries under study (Jordan, Morocco, Syria and Tunisia). Therefore, for sake of comparability, the analysis focused only on the parameters that were relevant for all (or most of) the countries under study. A methodology for the assessment of rangeland degradation was , however, developed for the study, and is included in the BAM.

2.3 The level of analysis

The benefits arising from improved environmental conditions can in principle be analysed in three ways: qualitatively, quantitatively and monetarily - depending on the type and amount of information available.

1. In **qualitative terms;** providing a full description of the nature of the benefit, the people, land areas, sectors and services affected and, when relevant, an indication of the spatial distribution of the benefit (for example, as a map showing locations or regions in the country affected, or the neighbourhoods or social groups affected in urban areas). This is the easiest approach and is applicable to all parameters.

2. In **quantitative terms;** whenever quantitative data are available (e.g. cases of morbidity/mortality avoided etc.), to indicate the actual, relative or proportionate scale of the benefit arising from the environmental improvement identified. For example, the improvement of ambient air quality and/or water quality can lead to a quantifiable reduction in the number of cases of disease and early mortality. The improvement of water quality and protected areas management can lead to increase in the number of fish and in the number of bathers. Improved management and restoration of forests and wider green infrastructure around population centres can lead to the increased provision of cleaner water (quality and quantity). Reduced deforestation can avoid the loss of a certain amount of carbon and afforestation increase carbon sequestration.

   This approach is more data intensive and is applicable to several but not all the parameters, depending on the data available and the possibility to link environmental improvements to actual physical effects.

3. In **monetary terms**, when possible. This approach multiplies the quantitative benefits identified above by a money unit value (or a range of values) to give a monetary value of the benefit to society of a certain environmental improvement. Unit values include the value of a tonne of carbon, hospitalisation costs, value of a tonne of fish etc. The overall value to society can be the amount of money saved if a certain improvement is made (e.g. avoided hospitalisation costs from avoided illness across the population), market values of products or savings (e.g. increased revenues from fisheries locally or nationally, increased total value of carbon stored) or a measure of people's willingness to pay (WTP) for a benefit (e.g. for access to clean drinking water, river or bathing water quality). Such economic values may be obtained from cost data for specific services (e.g. cost of water treatments), market values for commodities (e.g. fish, carbon), survey data documenting WTP responses, modelling studies or benefit transfer studies. A discount rate can be applied to the monetisation of each benefit e.g. if Net Present Values (NPV) are used, but this was not the case in this study.

   This approach is the most data intensive and is applicable only to a smaller sub-set of parameters. There are also some methodological limitations which make the analysis of certain issues more difficult than of others, at certain scales. For example, assessing the benefits of water purification or flood control mitigation via natural capital (e.g. local forest or wetland) is possible for a city or town, but doing so for a country as a whole will

either be majorly resource intensive (requiring case by case analysis for all major agglomerations), or methodologically questionable if using benefits transfer, as the benefits are so site specific. For carbon storage, on the other hand, a tonne of carbon can be taken as having the same value wherever it is stored, making assessing the value more feasible.

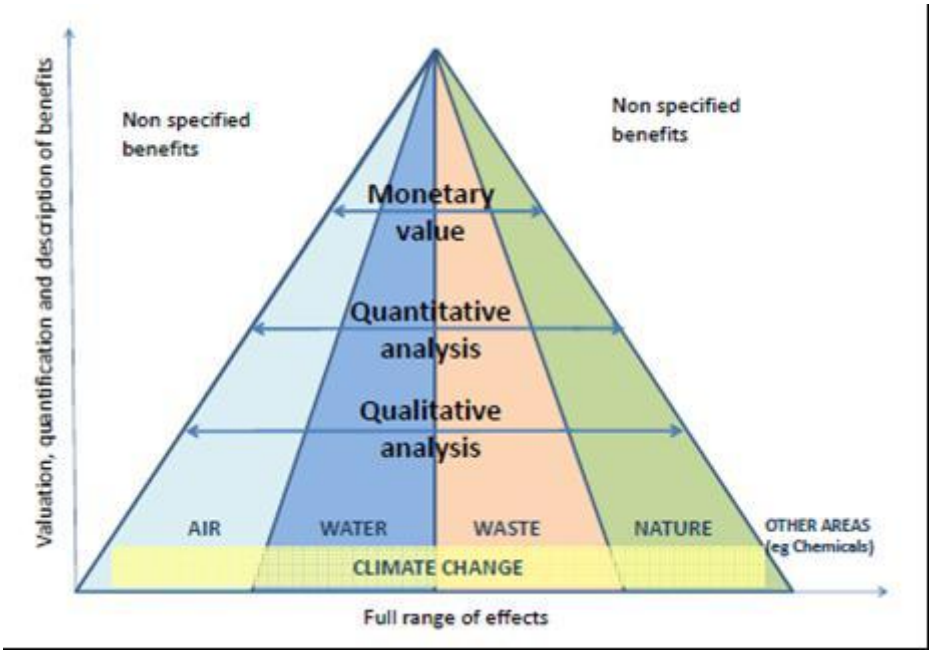
The adoption of this three-level approach is important as the availability of suitable data will typically vary between each parameter and between countries, and methodological tools are easier to apply for some issues than others.

The feasibility of undertaking complex quantitative and monetary analysis also depends on the scope of a BA and the resources and expertise available. In general, most benefits are identifiable in qualitative terms, a subset of them in quantitative terms and a smaller set in monetary terms.

This leads to a pyramidal assessment (see Figure 2.1 below) of the benefits of environmental improvements, whereby detailed values can be given for a small range of benefits while the value of several benefits remain unknown. This may result in many benefits being overlooked as no monetary value can be attached to them. For this reason it is important to ensure that the full range of benefits arising from enhanced environmental protection is portrayed to some extent, and that the BA is not constrained by focusing only on the elements that can be quantified or monetised.

A BA should therefore look at all of the three approaches, trying to develop a representative picture of the benefits. In some cases when national data do not allow a detailed analysis, local case examples can be valuable to help communicate issues relating to particular benefits. In any case, eventual future country assessments should also present the spatial perspective – indicating where the benefits occur and also, ideally, providing insights into spatial interconnectivity - e.g., which forest, grassland or wetland offers which services to which town or city; and where action in one area leads to benefits further afield (e.g., marine protected area and restoration helping fishing communities, reduced emissions from urban sewage leading to improvements to certain water bodies and leading to benefits to range of communities). Demonstrating the interaction between actions and beneficiaries can be important to support the implementation of given measures and their associated investment.

Figure 2.1 Benefits pyramid: qualitative, quantitative and monetary assessment



2.4 Methodology Steps

This section presents an overview of the key steps that were undertaken for the benefit assessments. The way these steps apply to each of the parameter is described in detail in the BAM.

The process to carry out a BA can be broken down into the following 5 main stages:

1. **Define the current state of the environment (reference point):** a description of the current environmental conditions is needed to establish a reference point against which one can assess improvement in the environmental parameters. This is done for the year for which the latest data generally available – 2008.

2. **Define the baseline to 2020:** under this step baseline projections of how the state of the environment is expected to change by 2020 have to be made, on the basis of projected developments in the underlying economic and demographic factors that affect the environment. This is required for a range of the parameters because, as the work will look at achieving certain targets in 2020, it will need to compare future improvements with future 'no (additional) action' scenarios. Key data for this step include, for instance, economic growth (GDP) and population growth. Within this study, given its timescale and resources, only very pragmatic baselines could be developed, focusing on only the key issues that were likely to affect the overall assessment (see BAM).

3. **Establish the targets:** in order to establish what the 'environmental improvements' could be, theoretical environmental targets to be met by 2020 have been set for each of the parameters to help in the assessment of benefits. Common targets have been set across the countries for each of the different issues. In a few cases, some country variants were also adopted to complement the cross country common assessment (e.g.

for RES). In other areas – e.g. halting deforestation by 2020 - the target only applied to a subset of nations and hence the focus moved to the value of the existing forest stock.

The targets are based mainly on selected international protocols, conventions and/or standards and, in some cases, on rules of thumb. An overview is provided in the table below. The targets are also presented in more detail in the BAM.

The targets are thus not explicitly related to actual policies existing in these countries (as this study was not doing an assessment of national policies), but should be seen as a theoretical indication of what an 'ideal' (yet feasible) environmental target can bring in terms of environmental improvements, to help assess and communicate the level of benefits. Clearly countries do not have the same policy aims, nor indeed do they have the same 'starting points', capacities and opportunities for progressing and implementing environmental policy agendas. In some cases existing political commitments will match those used as the basis of the analysis here, and in other cases the ENPI wide targets might be too ambitious or in other not ambitious enough. Some countries are thus likely to be able meet the targets earlier than others. Nevertheless, for assessment and comparability purposes, a common reference year (2008) and a target year (2020) were adopted. The target year is believed to be near enough to be politically relevant, but far enough into the future to allow significant progress with ambitious action. The objective was in any case not to do an assessment of country policies, or 'judge performance or plans', and it is recognised that many countries have made considerable efforts in recent years that may not be picked up by having 2008 data (and sometimes older, where 2008 was not available) as a starting point. Similarly a range of countries have recently launched important initiatives to improve the environment or to realise opportunities (e.g. renewable energies). The country benefit assessments aim to offer evidence to support the commitment to these initiatives and not as a statement that nothing is being done, as that is generally not the case. In any case, the benefit assessment methodology developed under the project, including the targets, can be adapted more concretely to national circumstances by stakeholders in the countries.

4. **Compare the targets to the reference point and baseline:** this step requires the identification of the expected environmental improvements that could be achieved if the targets were met, by comparing the proposed target for each of the parameter with the reference points and baseline. For some parameters the comparison with the reference point is key (e.g., as regards river quality, or protected areas covered) and in others the comparison with both the reference point and the 2020 baseline is necessary to obtain due insights (e.g., access to quality drinking water, as the number of people benefits will increase not just because of investments but also due to population growth).

5. **Assess the benefits:** this step requires the assessment of the range of benefits (health, environmental, social, economics) that would be achieved if the targets were met. This will require the use a combination of qualitative, quantitative and monetary approaches (according to the data available).

Table 2.3 Overview of selected targets for each parameter

THEME	PARAMETER	TARGET	Rationale for target
AIR	1. Ambient air quality	**WHO guidelines for SO_2 NO_x PM O_3 and CO Otherwise CO in Air Framework Directive**	Based on WHO guidelines or GP-equivalent % reductions concentration.
WATER	2. Connection to safe drinking water	**100% connection (except isolated rural areas) to good water quality at tap *OR* (if info available) meeting WHO drinking water guidelines**	Rule of thumb - reduce the spread of water borne diseases, incidence of illness from poor water quality and social amenity of access to quality water.
	3. Level of sanitation and hygiene	**100% connection to sewage network (except isolated rural areas)**	Rule of thumb - major benefits from improved sanitation / hygiene in households.
	4. Level of waste water treatment	**100% secondary treatment in urban areas and main rural areas (>10,000 pop)**	Realistic target – primary treatment being insufficient to address environmental concerns, tertiary treatment being likely too advanced /costly.
	5. Surface water quality	**Various percentages of rivers and lakes improved to WFD good status (e.g. 85%, 65% etc. depending on current status)**	Inspired by EU Water Framework Directive & Bathing Framework Directive. Also: CBD COP10 Target #8: By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.
	6. Water resource use	**Lower Water Exploitation Index (WEI) by 20-40%**	Sustainable use and allocation is essential for meeting demand (at economic value, price of water). It depends on local conditions which most likely can only be established using a case study.
WASTE[13]	7. Waste collection coverage	**100% coverage of population with at least a bring-system for waste collection.**	Rule of thumb – modern environmental infrastructure for modern state.
	8. Waste treatment	**50% recycling (glass, paper, plastic, metals) 65% of biodegradable waste diverted from landfills**	Inspired by EU waste legislation.
	9. Methane emissions from waste	**Up to 50% capture**	Considered a reasonable level and used in previous benefit studies.
NATURE	10. Level of biodiversity protection	**Reach at least 17% of total land area and 10% marine area covered by protected areas (PA);**	Johannesburg WSSD target, MDG: slow biodiversity loss + CBD COP10 Strategic Plan for 2011-2020: Target #11 - 17% land area, 10% marine area covered by

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

THEME	PARAMETER	TARGET	Rationale for target
		100% of PAs in favourable condition status.	protected areas.
	11. Deforestation levels	**Halt deforestation by 2020**	CBD COP10 Strategic Plan target #5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
	12. Level of cropland degradation	**Improve land quality to reduce crop yield losses by a half**	
	13. Level of rangeland degradation	**Improve rangeland fodder productivity to reduce degradation occurred by a half**	
CLIMATE CHANGE	Deforestation	*(covered under nature)*	Preserve carbon storage and sequestration values of forests – *Green carbon.*
	Methane emission from waste	*(covered under waste)*	Methane, a key green house gas (GHG), has high global warming potential (GWP).
	14. Uptake of RES	**At least 20% of energy demand supplied by RES by 2020**	Inspired by EU policy.
	15. Climate change adaptation	**Keeping temperature rise to 2 degrees Celsius**	International Panel for Climate Change (IPCC)

Note: As an exception, in some countries sensitivities can be applied to the targets to assess other 'ambitions', where considered doable and offering useful value added, and should ensure that results are meaningful, notably where the targets above are obviously inappropriate for a country given its current situation (e.g., already beyond the 20% RES target).

As noted above, the targets reflect a range of actual commitments (e.g. CBD Strategic Plan), contributions to objectives and targets (e.g. MDGs), and areas where commitments could be forthcoming (e.g. for renewable energies, where not all countries have set targets). The choice of 'targets' within this study has been made to facilitate an assessment of benefits so as to derive insights on the benefits of potential environmental improvement. National targets will in some cases coincide with the targets chosen in other areas there will be quite some country variation (and country targets are naturally also dynamic as they are regularly revised). In summary, the targets should be seen as useful tools for assessment and development of a useful evidence base for countries, and not a policy recommendation for countries, as this is clearly outside the scope of this assessment.

It should be noted that the methodology used in this study (and described in the BAM) is but one of the possible pragmatic approaches to translate benefits into actual values. Other methods are also possible and more sophisticated and accurate approaches may also be more feasible in the future, when better data and analytical tools become available, or when resources to explore issues in more depth become available.

2.5 Interpretation of the results

As each country is characterised by its own economic, political and social conditions, and as the basic data used in these analyses are not always comparable across countries, one should not compare/benchmark countries against one another and the benefits calculated here should be seen in their context. Similarly the regional totals should be seen as illustrative estimates, and. The values, however, should prove a useful additional evidence base on importance of improving the environment. What the exact value will be will depend on national choices as to the paths to a green economy.[14]

The ambition of this study was to provide indicative values for improving the environment across a range of parameters. This built on data that in many areas were robust, but in others weaker. A range of often pragmatic assumptions were adopted in the study given the need for comparable treatment across the ENPI countries and given the limited resources.

When interpreting the results expressed in monetary terms, it should be borne in mind that these are derived from a mix of market and non-market values. The market values will directly affect GDP (e.g. capturing the value of improved agricultural output). There are other effects – such as a reduced risk of suffering from chronic bronchitis – for which no market prices exist, and so do not affect GDP, but which people value. These values can be estimated through various methods and are used to present benefit estimate results in monetary terms in order to help communicate the importance of the issues.

Furthermore, where values relate to benefits related to international process (i.e. carbon prices used as regards climate change mitigation) the values are in Euros, and where the relate to national values (e.g. health benefits associated with avoided impacts of air pollution, or other preferences), they are in € PPP (Purchasing Power Parity). PPPs are widely used as an alternative to monetary exchange rates when making international economic comparisons. They are, in effect, 'real' exchange rates, based on a comparison of the relative purchasing power of each country's currency. Purchasing power parities equate the purchasing power of different currencies. This means that a given sum of money, when converted into different currencies at the PPP rates, will buy the same basket of goods and services in all countries, thus eliminating differences in retail price levels between countries.

The range of carbon values used in this project derives from different sources. For an assessment of avoided damage, the marginal value of damage from a tonne of carbon can be used and is a non-market value obtained from modelling the marginal change to the aggregate impacts of climate change in monetary terms as a result of the additional tonne of carbon emitted. Alternatively, for the assessment of costs of action to reduce carbon emissions, national marginal costs of emission reductions can be used, or if trading markets

[14] Countries also have a range of specific interests not just in the fields covered in this report, but more widely (e.g., energy efficiency, desertification, chemicals), or needs for particular depth on issues covered here (e.g. jobs, rural livelihoods and poverty; or natural capital and tourism). Not everything could be covered by the existing study, and this should not be taken as a study judgement as to whether something is important or not - all environmental issues merit attention and it is a question of data, resources and tools. There is a growing discipline of benefit assessment and even in difficult areas (e.g. chemicals) which should become increasingly accessible for benefit assessment in due course.

exist, then a Clean Development Mechanism (CDM) or trading price could be used (e.g. EU-emission trading scheme (ETS) price), to the extent that there is market access. This selection of values can quickly get complicated by the range of estimates available, and some countries have offered guidance values. Broadly speaking, these guidance values present marginal damage cost estimates that are higher than the costs of national action. Whether these latter cost estimates are higher or lower than the market prices given depends on the strictness of the emission targets/objectives and potential for action in both the domestic domain and in the carbon markets. In all cases the values will change over time.

Finally, those values relating to wellbeing and human health (e.g. avoided bronchitis or diarrhoea from polluted air or water, and avoided early mortality), have been applied using a conventional benefits transfer approach. In this approach, a value derived in one country (e.g. the willingness to pay to avoid bronchitis) is 'weighted' by the relative GDP/capita between the country from where the value was derived and the 'target' country, in this study one of the ENPI nations. While this is acceptable at one level – peoples' willingness to pay for clean drinking water does tend to be broadly related to income levels (and GDP/capita a proxy for this), for health this is sometimes regarded as controversial - most notably with regard to the value of avoiding early mortality from pollution. In this case, this approach can lead to the interpretation that lives in countries with lower GDP/capita are in some sense not valued as highly as those in countries with higher GDP/capita. To avoid this complication, it is best, ideally, to use national willingness to pay estimates of 'values of prevented fatality'. Where these are not available, the conventional benefits transfer approach with weighting may be used, noting clearly - to avoid misinterpretation - the caveat that the transferred estimate is an approximation, only, of the preferences of the citizens in the target country. Alternatively, where income levels between the original country and the target country are not too disparate, it is defensible (from an economic perspective) to use the original value, unadjusted by weighting given the substantial uncertainties still remaining in the empirical estimation of such values. It is also of course defensible (from a moral perspective) to have no GDP/capita weighting. In either case, care must be taken to be transparent as to the method and assumptions and not to confuse the instrumental benefit of an economic assessment (highlighting that lives should be protected) with the unintended consequence following from the mis-interpretation of 'value of lives varying across nations' (where 'traditional' GDP/capita weighting is applied). As a final cautionary note, it is likely to be the case in practice that if no assessment is done, the risk of losing lives is higher since the health effect may be under-valued in a policy appraisal. So whilst if valuations are used (as they are here) then one faces the controversy, the potential to save lives arguably merits the controversy.

3 AIR QUALITY

Key Messages: Air

- Air quality is currently a significant environmental hazard across the Southern ENP countries, resulting in sizeable negative impacts on public health, ecosystems, crops and materials. Key sources of emissions are, for instance, heavy traffic (e.g. in Egypt, Lebanon, Syria, Jordan), the construction sector (e.g. in Jordan, Lebanon and Syria) and other industrial and agriculture activities (e.g. agriculture waste burning in Cairo).

- Principal benefits resulting from reduced emission levels of a range of pollutants include: improvements in human health (pulmonary and cardiovascular illness); higher crop yields, (nine crops including potatoes, barley and wheat), and; reduced soiling of building materials. Air pollution impacts on ecosystems and cultural heritage would also be reduced as a result of lower emissions.

- Total emission reductions of SO2, NOX, PM, NMVOCs and NH3 as a result of a 50 per cent reduction from projected 2020 levels in all the Southern ENP countries are presented below.

Air pollutant emission reductions in ENPI South countries *(thousand tonnes)*

NH3	NMVOC	NOx	PM10	SO2
377	1574	776	731	1322

- As a result of these emission reductions, the total quantified benefits realised domestically as a result of each country's reductions could be as much as €32 billion (in PPP) per year, of which 60 per cent of these benefits – the largest in absolute terms - would be made within Egypt, as a result of the emission reductions in that country. The numbers of premature deaths and cases of chronic bronchitis that could be avoided annually rises up to between 19,000 – 60,000 and 36,000 – 117,000 respectively by 2020.

- According to first indicative estimates made here, benefits of similar size could be realised per annum in 2020 if changes in impacts that result outside national borders as a result of domestic reductions were also considered. Benefits to human health are estimated to account for around 90 per cent of all the quantified benefits, due to reductions in incidence of respiratory and cardio-pulmonary illnesses.

- These results therefore suggest that – as being initiated in many of these countries – future regulation should address both stationary and non-stationary sources and consider technological options as well as spatial planning.

- Air quality strategies are likely to be more cost-efficient if they are designed to exploit synergies that exist with climate change policies that regulate greenhouse gas emissions. Such synergies should therefore be recognised in the design of national and regional environmental policies.

3.1 Ambient air quality

3.1.1 Introduction

This sub-theme assesses the aggregate benefits from improved air quality resulting from changes in the ambient levels of a number of pollutants including ozone, (O_3), particulates, (PM)[15], non-methane volatile organic compounds (NMVOCs), sulphur dioxide, (SO_2), nitrogen oxides, (NO_x), and ammonia, (NH_3).
Air pollutants may be released by either stationary sources such as those emitted from the stack of a coal-fired power plant or of an industrial facility, or by moving sources which include, for example, automobiles, buses, trucks, rail and ship transport. Air pollution is now a major concern especially in urban centres, where most of the industries and vehicles are concentrated. With the growing concern, there has recently been increasing awareness of the diverse and complex impacts of air pollution and of the benefits of taking action.

Air pollution causes a wide range of human health, social, economic and environmental problems. The presence of air pollutants in the air can result in pulmonary and cardiovascular illness and early mortality. They can damage vegetation and buildings, including the cultural heritage. Local phenomena, like the 'black cloud' of smoke generated every autumn in Egypt, strongly affect the population and are recognised as crucial problems. Over longer distances such pollutants may be deposited as acid rain leading to acidification and/or eutrophication of ecosystems such as forests and fresh waters and affect economically important resources such as fisheries. As a consequence, regulation of the emissions of such pollutants through the design of public policy is spreading and strengthening globally.

In this project, we derive estimates of the benefits from reducing emissions of the pollutants listed above by 50 per cent from projected baseline levels. The size of this reduction is broadly consistent with those applied in previous analyses of environmental regulation in EU and other neighbouring countries (Ecotec et al, 2001). This reduction is intended to be broadly representative of that which might result from adopting the level of regulatory effectiveness currently being implemented in the EU and North America.

3.1.2 Current status in the region

The pollutant emission levels in 2005 in the Southern ENPI countries are presented in Table 3.1 and Table 3.2. The table shows that the emissions in Egypt are larger than for the other countries, whilst Morocco and Syria are the next largest emitters of these pollutants. This pattern reflects the size of the countries' individual populations, and their patterns of economic activity. For example, in Egypt air pollutants result principally from energy production, burning of agricultural waste, a variety of industrial activities as well as from transport. In the entire region, rising levels of car ownership – combined with poor levels of maintenance of an ageing car fleet – is an important contributory factor in determining air

[15] Includes PM2.5, (particles less than 2.5 micrometers in diameter, often known as "fine particles") PM10 (particles less than 2.5 micrometers in diameter), and PMco (particles greater than 10 micrometers in diameter)

pollution levels[16]. The construction boom in some countries, like Jordan, Lebanon and Syria, is also contributing to the worsening of air quality. A national perspective on current air quality is given by the example of Morocco in the box below.

Box 3.1 Current air quality status: Morocco

Air pollution in Morocco has been increasing the past 20 years as a result of industrial development and high levels of urbanization. Air quality is now a major concern in urban centres, such as Casablanca, Rabat, El Jaded and Safi. The principal atmospheric pollutants of concern are sulfur dioxide, nitrogen dioxide, and particulate matter. These pollutants are derived mainly from industrial and vehicle emissions and the burning of hydrocarbon fuels.

Stationary sources. Primary industrial sources of air pollution include petroleum refineries and power generation plants, as well as phosphate-processing units, cement factories, iron, steel mills, and petro-chemical factories that utilise fossil fuels with high sulphur content. Industrial air pollution is focused in industrial centres, particularly the Casablanca region, where a large proportion of the country's industries are located.

Mobile sources. Vehicle emissions reportedly contribute a majority of Morocco's air pollution, particularly in urban areas. Over 50 % of the vehicles are concentrated in the zone of Rabat-Casablanca. Emissions are significant because of the increasing number of aging vehicles, lack of emission controls, a general lack of engine maintenance, and the use of low-quality fuel with high sculpture and lead content. The transportation system, with its use of trucks for long-distance transportation of goods and poor railway systems, exacerbates pollution problems. Natural sources of air pollution include, in particular, dust and sandstorms.

Impacts of air pollution. Short-term exposure to nitrogen oxides, particulate matter, and sulphur dioxide above established standards presents a risk of transient acute respiratory symptoms such as coughing, wheezing, and reduced lung function, especially in asthmatic individuals. Epidemiological studies conducted in areas such as Casablanca, Mohammedia and Safi have shown correlations between air pollution and increased respiratory infections, bronchitis, asthma, and premature mortality.

In Rabat, fine particulates have an annual average concentration level of 243µg/m^3. PM^{10} level ranges between 70 and 123µg/m3, CO_2 concentrations reach 144µg/m^3, SO^2 concentrations vary between 8 and 144µg/m^3 depending on the region within the city. A correlation has been found between air pollution and health in a number of cities. Mortality, for example, has increased by 2% due to the increase of PM10 concentrations by 22µg/m^3 in urban areas (AFED 2008).

There has recently been increasing awareness of the diverse and complex impacts of air pollution in Morocco. Public and private sector establishments are becoming more interested in undertaking preventive measures to control air pollution, and there is a detectable shift from end-of-pipe treatments to a more pro-active approach, including cleaner production. National Cleaner Production Centres have been established to raise awareness, build the capacities of development partners, and support stakeholders. (UNEP, 2009).

16 Note that transport is also responsible for emitting other pollutants such as NO2, CO and CO_2 that are not included in Table 3.1.

Table 3.1 Pollution emissions by country in 2005 (thousand tons)

	NH3	NMVOC	NOx	PPM2.5	PPMco	PPM10	SO2
Algeria	56	856	195	5	2	7	85
Egypt	399	1051	445	437	268	704	740
Israel	26	262	246	40	24	64	245
Jordan	13	126	91	35	21	56	135
Lebanon	14	66	69	22	14	36	185
Morocco	105	168	154	172	105	277	491
OPT	21	120	58	20	12	32	92
Syria	78	383	243	120	74	194	417
Tunisia	41	117	53	57	35	93	253
Total	**754**	**3147**	**1553**	**908**	**555**	**1463**	**2643**

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

Table 3.2 GHG emissions by country in 2005 (thousand tonnes)

	CO_2 emissions ('000 tons)	Methane emissions ('000 tons of CO_2 equivalent)	Nitrous oxide emissions ('000 metric tons of CO_2 equivalent)	Other GHG emissions, HFC, PFC and SF6 ('000 tons of CO_2 equivalent)
Algeria	132618	24310	10330	110
Egypt	166679	32960	27810	1820
Israel	70389	1170	1820	1140
Jordan	20709	1610	1240	10
Lebanon	15319	980	1020	0
Morocco	45283	13240	15510	0
OPT	2982	n/a	n/a	n/a
Syria	68411	7960	9430	0
Tunisia	23109	4390	7230	30
Total	**545500**	**86620**	**74390**	**3110**

Note: CO_2 emissions for 2006. Source: World Bank 2010. World Development Indicators.

3.1.3 Benefits of improving air quality – qualitative assessment

The variety of benefits of improving the currently projected air quality baseline includes those listed in the table below.

Table 3.3 Qualitative description of benefits of reductions in air pollution

Environmental benefits	Description
Ecosystem condition improvements	– Reduced acidification from lower SO_2 and NO_x emissions – Reduced climate change impacts on impacts from lower SO_2 and NO_x emissions – Reduced damage to vegetation from low level ozone
Health benefits	**Description**
Lower incidence of acute and chronic disease	– Reductions in SO_2 imply lower incidence of cardiovascular and respiratory disease – Reductions in PM_{10} concentrations imply lower emergency-room visits due to asthma, and also hospital admissions on the grounds of respiratory diseases – Reductions in NO_x, when combined with ozone, organic compounds, particulates and sunlight result in corresponding reductions of photochemical 'smog' that otherwise cause respiratory impairment, irritation of the eyes and mucous membrane, with asthma patients and young children.
Social benefits	**Description**
Improved quality of life	– Reduced health effects – increased visibility in urban areas, as a result of reduced photochemical smog – Transport emissions are a major contributor to poor urban air quality and compliance with them is one component of any comprehensive social improvement policy.
Increased amenity value of improved landscapes, nature and air quality	– through reduced pollution pressure
Reduced damage to cultural heritage, including among other things, historic building surfaces in city centres.	– Black smoke from traffic is a prime cause of discolouring of buildings, including public buildings of important social cultural value, such as monuments, historic buildings, churches, museums. – Exposure of building materials to SO_2 deposition from acidification results in premature ageing. – Reduced blackening and erosion of surfaces (from SO_x and NO_x emissions from traffic fuel use), can improve the social appreciation and use of city centres and cultural heritage.
Economic benefits	**Description**
'Green technology' industries	– Increase in demand for products and processes that result in lower air pollution emissions, and subsequent employment opportunities, as long as such industries are domestic.
Increased visits to improved landscapes and natural areas	– Increase in tourism and associated expenditures in local areas.
Lower material cleaning costs	– Reductions in expenditures on building surfaces soiled by particulates.
Crop damage reductions	– Reduced crop damage from lower SO_2 and NO_x emissions – Reduced crop damage from low level ozone

3.1.4 Benefits of improving air quality – quantitative and monetary assessment

On the basis of modelling work undertaken in the project broad quantitative estimates of the benefits have been derived of meeting the target of 50 per cent reduction in pollutant emissions (SO_2, NOX, PM, NMVOCs and NH_3) from the 2020 baseline. Quantification is of the physical health impacts as well as of overall monetary benefits that include health, crop and material impacts. Table 3.4 presents the estimates of physical health benefits, expressed in terms of the number of premature deaths avoided and the numbers of cases of chronic bronchitis (equivalents) avoided in the individual country from emission reductions in that country[17]. Reflecting the pattern of emissions highlighted in Tables 3.1 and 3.2, Table 3.4 shows that the majority of health benefits in the region are realised in Egypt.

Table 3.4 Physical premature mortality and morbidity impacts avoided in year 2020[18]

	Deaths			Cases		
	Low	Central	High	Low	Central	High
Algeria	320	560	1,050	620	1,080	2,020
Egypt	13,870	24,000	45,000	26,590	46,000	86,250
Israel	40	70	130	75	130	245
Jordan	400	700	1,310	780	1,350	2,530
Lebanon	220	375	700	330	560	1,050
Morocco	2,540	4,400	8,250	4,910	8,500	15,930
OPT	130	220	410	250	440	820
Syria	807	1,500	2,810	1,620	2,800	5,250
Tunisia	520	900	1,690	1,010	1,750	3,280
Total	**18,920**	**32,725**	**61,360**	**36,200**	**62,610**	**117,400**

Table 3.5 expresses the benefits of avoided premature mortality in terms of each country's population. Again, Egypt has the highest benefits across the countries considered in this modeling exercise.

[17] Note that whilst the individual country reports present central estimates only, in this report we represent the uncertainty in all stages of the modelling (including emission dispersion, exposure-response functions and monetary valuation) in presenting "low" and "high" estimates. The extent of this range is determined by the findings of uncertainty analysis in the EU context.

[18] Note that the results for Israel are not comparable with those for the other countries since the emission reduction modelled was a 50% intensification in the current rate of change (generally reductions) as detailed in the country report.

Table 3.5 Annual deaths avoided per 100,000 population

Country	Annual deaths avoided
Algeria	2
Egypt	29
Israel	3
Jordan	12
Lebanon	9
Morocco	14
OPT	6
Syria	7
Tunisia	9

Table 3.6, below, shows the estimated benefits in monetary form – both in terms of million Euros and in terms of what these equate to as percentages of projected GDP in 2020. Egypt and Morocco rank highest under both these metrics. Whilst there have been very few previous studies undertaken in this region, two studies – World Bank/METAP (2004), and World Bank (2002), assessed the total damage costs that can be attributed to air pollution in Syria and Egypt, respectively. The Egypt study finds a range of 0.7% and 2.3% of GDP, whilst the Syria study finds a range of 0.8% – 1.8%. These results are similar, the higher results in being principally attributed to the higher valuation of mortality. The benefits accrue to the four impact categories in the following proportions: mortality, (70 per cent of the totals), morbidity, (20 per cent) crops, (6 per cent) and building materials (4 per cent). Air pollution modelling in Europe has repeatedly shown that – due to their dispersion by atmospheric wind currents - the emission of pollutants in one country may result in significant impacts in other countries within certain geographical areas. We have explored the potential for making estimates of these trans-boundary effects. However, the degree to which it is appropriate to transfer unit value transfer values from other geographical contexts to the ENPI South context is limited and it has not been possible to make credible country-based estimates. At a regional level, though, the benefits may be at least as large as domestic impacts. There is considerable uncertainty in these results and they should be treated as indicative only. Nevertheless, they demonstrate the potential importance of such effects.

Table 3.6 Annual Compliance: Total domestic benefits – 2020

	€ million PPP			per cent of GDP		
	Low	Central	High	Low	Central	High
Algeria	248	429	805	0.1	0.2	0.3
Egypt	7,149	12,365	23,185	1.6	2.7	5.1
Israel	107	188	347	0.05	0.09	0.16
Jordan	213	368	690	0.6	1.0	1.9
Lebanon	263	455	853	0.6	1.0	1.9
Morocco	1,022	1768	3,314	0.8	1.3	2.4
OPT	40	69	129	0.3	0.5	0.9
Syria	369	638	1,196	0.3	0.6	1.1
Tunisia	401	693	1,300	0.5	0.9	1.7
Total	**9,811**	**16,970**	**31,820**	**0.5**	**0.9**	**1.7**

3.2 Conclusions - air related benefits

The project has confirmed that air quality is currently a significant environmental hazard across the Southern ENPI countries. International research has previously established that air pollution causes a wide range of human health, social, economic and environmental problems. The presence of air pollutants in the air can result in pulmonary and cardiovascular illness and early mortality. They can damage vegetation and buildings, including the cultural heritage. Over longer distances (i.e. many hundreds of kilometres) such pollutants may be deposited as acid rain leading to acidification and/or eutrophication of ecosystems such as forests and fresh waters and affect economically important resources such as fisheries.

The analysis of projected emissions of particulates, Nitrogen Oxide, Sulphur Dioxide, Non-Methane Volatile Organic Compounds and Ammonia that considers human health, crops and damage to building materials has shown that there are substantial benefits to be gained from the reduction of these emissions within the ENPI South countries. Based on the high results presented above, total domestic benefits (i.e. benefits realised in the individual countries in which the emissions are being reduced), of reducing emissions of these pollutants by 50 per cent from their projected 2020 levels in all the Southern ENP countries could be as much as €32 billion per year. Over 60 per cent of these benefits would be made within Egypt, as a result of the emission reductions in that country. According to the estimates made here, benefits of similar size could be realised if trans-boundary impacts (i.e. impacts that result outside national borders as a result of domestic reductions) were also considered. Benefits to human health are estimated to account for around 90 per cent of all these benefits.

The low and high ranges of results that are presented in the tables above reflect the modelled uncertainties. They do not, however, reflect the additional uncertainties that are introduced in the process of transfer of results from previous studies (e.g. in epidemiological exposure-response functions and monetary valuation) that were undertaken in non-Southern ENPI countries. Contextual differences such as these may well be important. Similarly, it should be highlighted that the air quality modelling is limited in the number of pollutants incorporated, since it does not include NO2, Heavy Metals, PAHs etc., and does not consider all the potential impacts. Potentially important impact categories that are not considered quantitatively include ecosystem damages; again, these are thought to be important. At the same time, it should be noted that the methods and data needed for quantification of air pollution impacts are more advanced than for other environmental themes considered under this project (e.g. water, nature etc.). As a consequence, the quantitative results for air are more complete than other media and cannot be directly compared in order to prioritise regulatory resources across media.

The project has indicated that the benefits of reducing emissions of air pollutants by 50 per cent in 2020 in the Southern ENP countries are significant to the welfare of the populations of these countries. The central country-specific results show a range of benefits to these countries equivalent to between 0.2 per cent and 2.7 per cent of national GDP. Accounting for trans-boundary impacts may treble these totals.

The range of results reflects patterns of economic activity in these countries, including their industrial composition, the proximity of population centres to large polluting enterprises, and patterns of car ownership and the age and maintenance regimes of such vehicles. These results therefore suggest that – as being initiated in many of these countries – future regulation should address both stationary, i.e. point, sources and non-stationary, i.e. transport, sources and consider technological options as well as spatial planning. Future research should focus on more detailed, context-specific modelling of the air quality impacts, as well as using this information to conduct cost-benefit analyses of alternative air quality regulatory strategies.

4 WATER

Key Messages: Water

- Provision of a centralised piped drinking water varies across the South ENP countries. For urban populations, the highest levels of provision are found in Israel, Egypt and Lebanon, and the lowest in Algeria and the occupied Palestinian territory. For rural areas there is more variation between countries. In Israel almost all rural populations are connected, but in some countries connection rates are low, e.g. in Algeria and Syria.
- The level of household connection to the sewage network also varies. In some urban areas this can be relatively high, such as in Israel, Algeria and Syria, but some urban populations are not well connected. However, for rural populations the degree of connection to sewage networks is much more diverse, ranging from 100 per cent connection in Israel, to only 4 per cent in Jordan.
- Information on the status of hygiene practices is generally not available in most countries. However, substantial improvements in hygiene practices can be achieved in most countries in the world, with substantial reduction in diarrheal disease and transmission of respiratory infections.
- Meeting targets of full connection to piped drinking water and sewage collection would mean an additional 45 million people would have reliable and safe piped water to premises, and an additional 92-106 million people would have connection to a sewage network system in 2020. This will be beneficial in particular in poor rural and urban areas.
- Overall, across the region, the benefits that would accrue from improved drinking water quality, sewage connection, and improved hygiene practices would be between 45 million and 100 million annual cases of diarrhoea avoided and between 4,350 and 9,500 deaths avoided in 2020.
- The annual monetised benefits that would accrue from improved drinking water quality and sewage connection and improved hygiene practices would be between €2,136 million and €4,710 million for morbidity, between €1,673 million and €3,700 million for mortality, which would give total annual benefits of between €3,808 million and €8,412 million. These benefits represent between 0.06 per cent and 0.99 per cent of the GDP of individual countries in 2020.
- Wastewater treatment varies across ENPI South, but in many cases treatment plants are often lacking, but in Israel there is extensive provision of the service. Improving levels of treatment would reduce pollution of surface waters with benefits for ecosystems and for health through reduction in contamination of drinking water sources and recreational bathing areas.
- Surface water quality varies, with many water courses suffering from pollution, often from old or inadequate wastewater treatment infrastructure, sewage discharges, industrial pollution, and agro-chemical run-offs. Improving this would bring significant benefits for residents and users, such as fishermen, and property values.
- The benefits of meeting water quality improvements vary between €31 and €240 per household per year, which corresponds to 0.10-0.86 per cent of the GDP of individual countries in 2020.
- Water scarcity is a serious problem across ENPI South, for instance in Egypt and Syria. Droughts cause significant economic damage and better water management would bring additional economic, as well as social and environmental benefits.

4.1 Overview

The provision of adequate and safe water supplies to the populations and economic activities (including agriculture) in the countries of this region is a major challenge and one that often forms a subject for significant political debate. Water scarcity is a widespread and long-term problem. Water pollution has increased and provision of safe drinking water to populations in much of the region is problematic. The situation is summed up in the World Bank (2007) report on water scarcity: 'Water problems ripple through the social and economic spheres—as people fight over water allocations, as farmers see their incomes shrink because irrigation water does not arrive in their fields, as households spend time and money coping with unreliable water supplies or with none at all, and as children get sick because of poor sanitation. And if the present is grim, the future will be bleaker. Problems are predicted to worsen as competition for limited or degraded resources intensifies.'

A large number of the countries in this region have areas that are true deserts and areas that are semi-desert and have limited water resources. Therefore, water scarcity is not only a current challenge, but also an issue that has shaped the development of societies for several centuries. In addition, the water resources are unevenly distributed in some of the countries. In Morocco for example, water is relatively plentiful in the north, whereas water-scarce areas are located mostly in the south. The threat of climate change is considered likely to exacerbate the issue, in particular by increasing the frequency, length and gravity of extreme events, such as droughts and floods.

However, it is important to note that many parts of the Maghreb, coastal Egypt and the Levant have in the past had sufficient water to sustain the local population (within the general conditions of a Mediterranean climatic region). Rather problems for water resources have now arisen due to increasing populations, pressure of agriculture for domestic and export markets and reduction in the utility of some aquifers due to salinisation. Several countries, such as Egypt, live below the international water poverty line of 1,000 m^3/capita. The lack of water in some areas has led to movement of people from rural areas to cities as 'water refugees' (Luomi, 2010).

The social dimension of water resources varies significantly across the region. The annual flooding of the Nile has, for example, shaped the nature of Egyptian society for at least six thousand years. The Tigris and Euphrates in Syria have also formed the basis for millennia of social development. More recently, the challenge of provision of sufficient water has been a key issue in shaping decisions in Israel and forms a major focus of disagreement with authorities in the occupied Palestinian territory. National allocations of water from the river Nile have also been object of debate.

Water pollution is a significant problem in many areas of the region. Lack of or poor treatment of waste water and industrial and agriculture discharges (sewage is often being released directly into water bodies or on the soil) combine to cause eutrophication of surface waters, resulting in hazards for people and changes to natural ecosystems. This effect is further exacerbated where water courses are over-abstracted so that the pollutants that are present become increasingly concentrated. In Israel, for example, some surface

waters are so over-abstracted that they their flows may sometimes be due only to discharges of waste water.

Transboundary water issues are not uncommon in the region, although these are limited to specific areas. There are some surface and ground water aquifers that traverse frontiers in the Maghreb and transboundary waters are an issue in the Levant. In particular the River Jordan and groundwater aquifers are a point of contention (both for quality and abstraction) between Israel, Jordan, the occupied Palestinian territory, Lebanon and Syria. Transboundary rivers with countries outside the scope of this report are also present in Egypt (as a downstream country) and Syria (downstream and upstream). Measures to improve the quality of water bodies and improve water use efficiency will, therefore, in many cases provide additional benefits to neighbouring countries. Conversely, some benefits from improved water quality will require measures to be adopted in neighbouring countries. Overall, as Luomi (2010) stated 'the region is in dire need of sound water management policies and practices that are based on multi-stakeholder engagement and transboundary cooperation'.

Pollution of Mediterranean and Atlantic coastal waters is a significant cross-border environmental issue in the region. The Euro-Mediterranean partners, including Morocco, have joined together in the 'Horizon 2020 Initiative'. The aim is to de-pollute the Mediterranean by the year 2020 by tackling the sources of pollution that account for around 80 per cent of the overall pollution of the Mediterranean Sea.

This chapter begins by considering the benefits from improving access to safe and reliable piped drinking water, connection to sewage network, and improved hygiene practices. It continues by examining the benefits from improved wastewater treatment. It then analyses the wider benefits that would arise from improvements to the quality of water bodies and concludes with a consideration of the benefits from addressing the issue of water scarcity.

4.2 Connection to safe drinking water and connection to sewage network and hygiene conditions

4.2.1 Introduction

A major cause of disease in human populations arises from exposure to infectious agents (viruses, bacteria and parasites) in drinking water and through poor sanitary conditions and hygiene practices. WHO estimates that 88 per cent of diarrheal disease incidence is globally caused by unsafe water, sanitation and hygiene.

Provision of safe drinking water and sanitation and promotion of improved hygiene practices is, therefore, an important development objective. Adopting and implementing measures to achieve this objective will have significant benefits for people, especially the urban and rural poor.

This first section assesses the benefits of improvements of:

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

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

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

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

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

4.2.2 Current status in the region

The degree of provision of piped drinking water supplies to populations in the countries of the region varies (Table 4.1). In all countries provision is greatest for urban than rural populations. For urban populations, the highest levels of provision are found in Israel, Egypt and Lebanon, with high levels also in Jordan, Syria and Tunisia and the lowest in Algeria and OPT. For rural areas the variation between countries is much more significant. In Israel almost all rural populations are connected and there are relatively high connection rates in Egypt and Jordan. However, levels for rural connection is lower in other countries, with the lowest in Tunisia, at 39 per cent. Some of the unconnected rural populations have access to other improved water sources (highest in Tunisia), but significant proportions of populations in Algeria and Syria do not have such access. Overall, lack of connection to good quality drinking water leads to significant disbenefits to the population, including increasing costs for alternative water provision. In Lebanon, for instance, water mismanagement has led households to pay up to three times the water tariff to diversify their water sources.

Table 4.1 provides an overview of the level of connection to sewage networks for each country in the region. In some urban areas this can be relatively high, but many countries still have significant proportions of the urban population without connection, although these are generally subject to other forms of improved sanitation. Israel has complete connection of its population to a sewage network and a reasonably high proportion of the urban population is connected in Algeria and Syria. However, it is evident that significant urban populations in some countries are not connected (although with access to other forms of sanitation). For instance, in the peri-urban areas of Morocco's about 2 million Moroccans have no access to water supply and/or sanitation services. The pattern for rural populations is more diverse – ranging from 100 per cent connection to the sewage network in Israel and only 4 per cent in Jordan.

Residents that do not have access to adequate water supply, often get their water from contaminated shallow wells, from water providers (who often charge a relatively high unit price) or from standpipes, which may require women or children to queue for several hours. Households that do not have access to basic sanitation use cesspits and poorly designed septic tanks, which risk increasing contamination of shallow groundwater.

Many of the poorest people remain without any form of sanitation. These deficiencies directly affect people's health and their ability to engage in income-generating activities—or, for children, to attend school. Connection to a sewage network provides the opportunity of minimizing pollution of water and land resources through central treatment of wastewater, as well as providing social benefits especially to the most vulnerable part of the population.

Table 4.1 Household access to drinking water and sanitation for each country in the region. All figures are as percentage of the population for 2008.

	Algeria			Egypt			Israel			Jordan			Lebanon		
	Urban	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**
Drinking water															
Piped water on premises	80	56	72	99	87	92	100	98	100	94	79	91	-	-	80
Other improved water sources	5	23	11	1	11	7	0	2	0	4	12	5	-	-	15
Unimproved water sources	15	21	17	0	2	1	0	0	0	2	9	4	-	-	5
Sanitation															
Toilet connected to sewage network	92	50	77	74 (87)*	18 (32)*	42 (56)*	100	100	100	67	4	53	-	-	66
Other improved sanitation	6	38	18	23 (10)*	74 (60)*	52 (38)*	0	0	0	31	93	45	-	-	32
Unimproved sanitation	2	12	5	3	8	6	0	0	0	2	3	3	-	-	2
Of which open defecation	1	10	4	0	0	0	0	0	0	0	0	0	-	-	0

**Note data for Egypt are from WHO/UNICEF 2010a,b, except for alternative figures for toilet connection (DHS in parentheses) and data on unimproved sanitation (World Bank 2010b)*

Table 4.1 continued

	Morocco			OPT			Syria			Tunisia		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Drinking water												
Piped water on premises	88	19	58	84	64	78	93	71	83	94	39	76
Other improved water sources	10	41	23	7	27	13	1	13	6	5	45	18
Unimproved water sources	2	40	19	9	9	9	6	16	11	1	16	6
Sanitation												
Toilet connected to sewage network	82	1	46	-	-	65	93	42	70	80	10	57
Other improved sanitation	1	51	23	-	-	24	3	53	26	16	54	28
Unimproved sanitation	17	48	31	9	16	11	4	5	4	4	36	15
Of which open defecation	0	38	17	0	0	0	0	0	0	0	14	5

Source: WHO/UNICEF (2010) and individual country reports on sanitation and sewage connection by WHO/UNICEF. Data in these reports are from nationwide household surveys such as the Demographic and Health Surveys (DHS) and the Multiple Indicator Cluster Surveys (MICS). See www.measuredhs.com and www.childinfo.org.

4.2.3 Potential environmental improvements

Targets to be reached by 2020

In order to determine the benefits of improved drinking water quality, sewage connection, and hygiene practices, it is necessary to identify targets for these services and practices so that the benefits that would arise from meeting these targets can be compared with the current situation. The targets for which benefits are assessed in this study are:

Drinking water:

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

Sewage connection:

- Achieving 100 per cent population connection (except in isolated rural areas) to a sewage network system.
- Upgrading to flush toilet (with sewage connection) for households with dry toilet or no toilet).
- Providing improved sanitation to households currently without such facilities in isolated rural areas.

Hygiene:

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

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

Information on the status of hygiene practices is generally not available in most countries unless detailed studies/surveys have been undertaken. What is clear, however, is that substantial improvements in hygiene practices can be achieved in most countries in the world. As the status of hygiene practices is not well known in the countries, the assessment in this study provides a benefit range for achieving the targets that, at the lower end, reflect the assumption that hygiene practices already are generally adequate for protection of

health and at the higher end reflect the assumption that practices can be substantially improved. In reality, benefits may be expected to be somewhere in between these two.

To estimate the number of beneficiaries and benefits of achieving the targets, the targets are compared to the percentage of the population currently equipped with piped water supply on premises, connection to a sewage network system, and good hygiene practices adequate for health protection. As hygiene practices are not well known, a range of 0-100 per cent is applied.

Improvements achieved by reaching the targets

The improvements from reaching the targets by 2020 are the difference between the specified targets and the baseline assumptions. Improvements include (Table 4.2):

- An additional 45 million people would have reliable and safe piped water to premises, and an additional 92-106 million people would have connection to a sewage network system.
- As some rural communities may be too isolated to have these services provided, an unspecified but relatively small number of these people would be provided plentiful and equally good quality water from other improved water sources and improved sanitation facilities if currently without such facilities.
- Potentially a large share of the population that already has piped water to premises would benefit from improvements in reliability and quality of water (so as to have safe water on premises) by improved central water treatment and rehabilitation and upgrading of existing water distribution networks.
- Depending on current hygiene practices, potential beneficiaries of hygiene promotion range from 0 – 234 million people, especially among the poor.

Table 4.2 The number of people in the region that would benefit from meeting the targets for piped supply of drinking water and connection to a sewage network (millions, 2020).

	Reliable and safe piped water supply to premises (new connections)	Improvement in reliability and quality of water among those currently with piped water supply	Connection to sewage network (new connections)	Improved hygiene practices
Algeria	11.4	0-29.2	9.2	0-40.6
Egypt	7.9	0-90.7	43.4 -56.8[1]	0-98.6
Israel[2]	0-0.29	0-8.8	0-0.6	0-2.9
Jordan	0.68	0-6.80	3.50	0-7.48
Lebanon	0.9	0-3.7	1.6	0-4.6
Morocco	15.2	0-21.0	19.4	0-36.2
OPT	1.20	0-4.25	1.9	0-5.45
Syria	4.5	0-21.9	7.9	0-26.4
Tunisia	2.8	0-8.9	5.0	0-11.7
TOTAL	44.6-44.9	0-195.3	91.9-105.9	0-233.9

Source: Estimates by the authors.

[1] Two results are reported depending on the baseline assumption for sewage connection. The upper bound is based on WHO/UNICEF (2010 a,b), while the lower bound is based on the Egypt DHS 2008.

[2] The lower bound is based on WHO/UNICEF (2010a,b) and the upper bound on IUED (2010) and ACRI (2009).

[3] Based on a range of 0-33 per cent of the population.

4.2.4 Benefits of improving drinking water quality, sewage connection and hygiene – qualitative assessment

Provision of reliable and safe piped drinking water, connection to a sewage network system (and flush toilet for those with dry toilet or no toilet), and practice of good hygiene (personal, household and community) have many benefits including health, environmental, economic and social benefits. A generic overview of these benefits is provided in Table 4.3. Some of these benefits (environmental, recreational, improved water resources) are discussed in the sections on Wastewater Treatment, Surface Water Quality, and Water Scarcity).

Table 4.3 Benefits of improved potable water supply, sanitation and hygiene practices

	Good quality piped water supply	**Connection to a sewage network system (and flush toilet for those with dry toilet or no toilet)**
Health benefits	• Good quality piped water supply, hygienic sanitation (flush toilets connected to sewage network) and good hygiene practices reduce the presence and transmission of pathogens, thus reduce the incidence of diarrhoea and other diseases (Fewtrell et al, 2005). • Reduced incidence of diarrhoea in early childhood contributes to improved nutritional status among children (World Bank, 2008). • Good hygiene practices (especially regular hand washing with soap) also reduce transmission of respiratory infections (Rabie and Curtis, 2006; Luby et al, 2005). • Reduced chemical, heavy metal, and other toxic substances contamination of drinking water reduce the incidence of associated diseases and health disorders.	
Environmental benefits	• Piped water connection and improved piped water quality do not lead to direct environmental benefits. • However, some benefits to habitats and water resources may accrue if water utilities press for protection or restoration of water quality of raw water abstraction sources.	• Sewage collection provides opportunity for proper treatment of wastewater which helps improve environmental quality including cleaner communities, cleaner urban and rural waterways (e.g., canals), cleaner rivers, lakes and coastal waters, and reduced pollution of land resources (see sections on Wastewater Treatment and Surface Water Quality).
Economic benefits	• Piped water connection with reliable and continuous good quality water reduces/ eliminates the need for: ○ household water storage tanks ○ spending time and money on household point-of-use treatment/ disinfection of water prior to drinking or on purchase of bottled water.	• The environmental benefits (see above) of sewage collection and proper treatment of wastewater can provide substantial recreational, tourism, and fishery benefits. • Good treatment of wastewater can also: ○ allows for wastewater reuse in agriculture

Table 4.3 Benefits of improved potable water supply, sanitation and hygiene practices		

	• Time savings from household connection can be used for income-generating activities for adults and improved education for children
	• Good quality piped drinking water also:
	  ○ reduces public and private health care expenditure
	  ○ improves labour productivity and reduces work absenteeism.
	• Access to good quality water can also provide cost savings to industries and make them more competitive, especially those relating to the food and beverage processing.
	• Rehabilitation of existing piped water distribution networks (to improve water quality) reduces water losses and thus costs of providing potable water.
		○ provides substantial cost savings in mobilizing and treating potable water, especially important in water scarce countries (see section on Water Scarcity).

Social benefits	• Piped water connection with reliable and continuous good quality water supply provides increased convenience from having potable water available at premises.
	• Access to good quality piped water also improves the public's perceptions of utilities and the state providing good quality services.
	• Skills can be transferred, in rural areas, through the use of local materials and water-system building techniques.
		• Sewage connection (and hygienic toilet on premises for those currently without it)
		  ○ increases household convenience (no needs for emptying and maintaining sewage pits/septic tanks; reduced access time to toilet facility or place of defecation),
		  ○ and reduces odours and nuisance from preventing direct sewage discharge into the local environment.

Source: Produced by the authors.

One of the economic benefits of providing safe and reliable piped drinking water can be illustrated by the fact that 16-21 per cent of households in Algeria and Jordan treat and/or disinfect their water prior to drinking because of concerns over health risks of drinking the water directly from the water source (Table 4.4). A substantial share of the population in Lebanon and Jordan also purchase contained water for drinking. Much of these practices, and associated costs, can be avoided if households receive safe and reliable piped water supply that is trusted by the households.

Table 4.4 Household point-of-use treatment of drinking water (per cent of all households, 2006-09)

	Boiling of water	Other treatments	Appropriate treatment, total
Algeria	1.2%	16.5%	16.4%
Egypt	0.4%	4.3%	<4%
Jordan	3.7%	17.9%	21.2%
Syria	1.3%	6.2%	4.5%

Note: Appropriate treatment is defined as methods such as boiling, filtering, and disinfection. 'Boiling of water' and 'Other treatments' add to more than 'appropriate treatment' because some households use more than one treatment method and some 'other treatment' methods are not considered 'appropriate treatment.' Source: DHS and MICS household surveys, 2006-2009 (www.measuredhs.com and www.childinfo.org). No data are available from DHS and MICS for Israel, Lebanon, Morocco, Tunisia and West Bank and Gaza.

It should be noted that improvement in drinking waste and sewage conditions can have wider social benefits, with potential know on effects on key issues like children health and school attendance rate, especially in rural areas. Providing good quality local water sources can lead to considerable time savings, by reducing the time required to fetch water and by making domestic tasks faster to complete, thus having a positive impact on school attendance for girls (Brody et al., 2008). A World Bank Rural Water Supply and Sanitation Project in Morocco succeeded in increasing girls' school attendance in six provinces by 20% over 4 years, in part attributable to the reduced burden on young girls to fetch water. (Fisher, 2006) - see also the box below.

Box 4.1 Improving water availability and sanitation in rural schools

The water sanitation situation in Morocco has improved over recent decades. However, many rural schools lack access to safe drinking water and sanitation facilities, which has a negative impact on the health of the children and on the school attendance rate. To improve the situation, the government set up in 2008 a joint programme to improve water availability, sanitation and hygiene in rural schools. The programme, which runs until 2015, primarily aims to increase the rate of schooling in general, and of girls in particular. In addition, it also aims to raise the environmental awareness of rural communities, through the children.

The objectives will be met by installing a system for drinking water provision in 14,911 rural schools and by installing sanitation facilities (i.e. toilet blocks and septic tanks) in 17,785 rural schools. As for the raising awareness component of the programme, the teachers are being trained on sustainable development and 'environmental clubs' are being set up in the schools. In 2009, 452 schools were equipped with sanitation facilities, and in 2010, 490. The cost to equip 2,150 schools is estimated at 258 million dirhams.

The main benefits of the programme are:

- An increased schooling rate of children, and of girls in particular (currently, while country-wide literacy rates are estimated at 39.6% among women and 65.7% among men, the female literacy rate in rural areas is estimated only at 10% (US Department of State, 2011).
- An improvement in the school performance of the children.
- A reduction in the incidence of diarrhoea and other diseases, which are closely related to water availability and sanitation. For example, a 1990 survey in Morocco revealed a high occurrence of diarrhoea, where 26.8 per cent of surveyed children had had diarrhoea in the previous two weeks (WHO,1991). Diarrhoeal diseases are big killers of children under 5 years old.
- Increased environmental and hygiene awareness of the children, and of the communities they live in.
- Reduction of the environmental impact of the schools.

4.2.5 Benefits of improving drinking water quality, sewage connection and hygiene – quantitative assessment

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

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

To assess the benefits of reaching the targets, the national population is classified into four groups according to their current status of drinking water supply and sewage connection (Table 4.5). By reaching the targets, groups 2-3 will receive either piped water supply or sewage connection and group 4 will receive both piped water and sewage connection, while group 1 already have both piped water supply and sewage connection.[19]

Tables 4.6 presents the expected reduction in annual incidence of diarrheal disease and diarrheal mortality from reaching the targets, distinguished by population groups 1-4 in relation to their current status of water supply, sanitation status (i.e. sewage connection), and hygiene practices. Among young children, these diarrheal disease reductions are expected to somewhat improve their nutritional status and thus reduce the risk of fatality from infectious diseases.[20]

Some clarification of these expected disease and mortality reductions are warranted. While groups 1-2 currently have piped drinking water supply, some households are likely to have sub-optimal water quality because they are connected to old, leaky networks and/or networks with fluctuating pressure and irregular continuity of supply. The water these households receive is therefore susceptible to contamination in the water distribution network even if water is well treated at central treatment plants. A 15 per cent reduction in diarrheal disease and mortality is therefore expected on average for these population groups from improved reliability and quality of piped water. For population groups 3-4, which currently do not have piped water supply, a 25 per cent reduction in disease and mortality is expected from receiving reliable and safe piped water supply to premises and in greater quantities than from their current water sources.

Connection to sewage network (and flush toilets for those currently without such toilets) for groups 2 and 4 reduces the risk of pathogen transmission and is expected to reduce disease and mortality by an incremental 20 per cent. If there also is substantial scope for

[19] Note that (1)+(2) corresponds to the population with “piped water on premises” in Table 4.1, and (1)+(3) corresponds to “toilet connected to sewage network”.

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

improvement in hygiene practices among any of these population groups, disease and mortality reduction is expected to be an additional 30 per cent.[21]

Expected disease reductions among each population group is therefore presented as a range, with the lower bound reflecting already good hygiene practices adequate for protection of health and the upper bound reflecting that hygiene practices are not adequate, and will by the target year be improved to adequate levels.

Table 4.5 Current water supply and sanitation coverage and Population distribution 2008

	Has piped water supply and sewage connection (1)	Has piped water supply but no sewage connection (2)	Not piped water supply but has sewage connection (3)	Not piped water supply and no sewage connection (4)
Algeria	70 %	2%	7%	21%
Egypt[1]	40%-54%	38%-52%	2%	6%
Israel	93.1% -100%	0%-3.6%	0%	0%-3.3%
Jordan	51%	40%	2%	7%
Lebanon	66%	14%	0%	20%
Morocco	44%	14%	2%	40%
OPT	63%	15%	2%	20%
Syria	63%	20%	7%	10%
Tunisia	55%	21%	2%	22%

[1] Two results are reported depending on the baseline assumptions(See Table 4.1).

Source: WHO/UNICEF (2010) and individual country reports on sanitation and sewage connection by WHO/UNICEF. Data in these reports are from nationwide household surveys such as the Demographic and Health Surveys (DHS) and the Multiple Indicator Cluster Surveys (MICS). See www.measuredhs.com and www.childinfo.org.

Table 4.6 Drinking water, sanitation, and hygiene improvements: expected average reduction in diarrheal disease and mortality by reaching the targets

Current water supply and sanitation coverage	*Water and sanitation improvement received by meeting the target*	*Reduction in disease and mortality*
(1) Has piped water supply and sewage connection	Improvement in reliability and quality of piped water	15-45%
(2) Has piped water supply but no sewage connection	a) Improvement in reliability and quality of piped water b) Sewage connection (new connection)	35-65%
(3) Not piped water supply but has sewage connection	Reliable and safe piped water supply to premises (new connection)	25-55%
(4) Not piped water supply and no sewage connection	Reliable and safe piped water supply and sewage connection (new connections)	45-75%

Source: The authors.

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

Based on the current distribution of population water and sanitation coverage, reaching the targets is estimated to reduce diarrheal disease and diarrheal mortality nationwide by 15-17 per cent in Israel to 33 per cent in Morocco if the entire population already has good hygiene practices adequate for health protection, and by 25-27 per cent to 65 per cent if hygiene practices can and will generally be substantially improved by 2020. In actuality, disease and mortality reduction likely falls somewhere in between the two values of this range, depending on current hygiene practices.

Table 4.7 Nationwide diarrheal disease and mortality reduction from reaching the targets, 2020

	If already good hygiene	*If hygiene is not adequate, & will be improved by target year*
Algeria	25%	57%
Egypt	26-29%	57-60%
Israel	15-17%	25-27%
Jordan	27%	58%
Lebanon	26%	58%
Morocco	33%	65%
OPT	27%	59%
Syria	24%	56%
Tunisia	28%	60%

Source: Estimates by the authors.

4.2.6 Benefits of improving drinking water quality, sewage connection and hygiene – monetary assessment

The data on the disease and mortality reduction benefits arising from improved drinking water quality, sewage connection and improved hygiene practices, together with information of current and baseline incidence of disease and mortality, can be used to estimate the number of cases of diarrhoea and deaths from such disease that would be avoided from improved drinking water quality, sewage connection, and hygiene practices by the year 2020. These results are presented in Table 4.8. It is important to note that lack of information on hygiene practices means that such estimates have to be presented as a low and high estimate based on the potential variation in how well such practices are implemented. Overall, across the region, the benefits that would accrue from improved drinking water quality, sewage connection, and improved hygiene practices would be between 45 million and 100 million annual cases of diarrhoea avoided and between 4,350 and 9,500 deaths avoided. These would be significant benefits.

Using the benefits methodology accompanying this report these instances of disease (morbidity) and deaths (mortality) can be monetised. Overall, across the region, the annual monetised benefits that would accrue from improved drinking water quality, sewage connection, and improved hygiene practices would be between €2,136 million and €4,710 million for morbidity, between €1,673 million and €3,700 million for mortality, which would give total annual benefits of between €3,808 million and €8,412 million. These are large

benefits and across the countries in the region would represent between 0.06 per cent and 0.99 per cent of the GDP of individual countries in 2020.

It is also important to note that the provision of safe drinking water such as through centralised supply can also have further economic benefits to populations. Access to safe drinking water is seen as important by people and, where this is not provided through piped systems, people may pay significant amounts to obtain safe water. Thus provision of drinking water through centralised systems has the potential to provide significant savings to household budgets. The case in the Box 4.2 provides a quantitative analysis of the current costs householders are faced with in obtaining safe drinking water in Lebanon and the savings that would result if such drinking were to be supplied to the whole population and if such a service were to be provided continuously, without interruption.

Box 4.2 Economic benefits of improved connection to water supply in Lebanon

Currently in the Lebanon most households use 2-3 sources of domestic water, including from piped supply, containers, wells, trucks and bottled water. The reason for multiple sources is often due to the fact that water supply is not perceived of good quality and is not continuous: it can range from 5.7 hours per day for some in the dry season to 10.8 hours per day in the low season.

Based on current water tariffs, if there was continuous supply, total household expenditure on water per year would be around PPP €167, whereas currently it is around PPP €529 due to the need to access more expensive sources. This situation is worse for those without any connection at all.

The 2010 National Water Sector Strategy has led the Government to plan to improve the level of water provision by 2015. To support this it plans to double the current water tariff to reach about €334 per household per year. However, this increase in price would be more than offset by householders no longer needing to access more expensive water sources.

An assessment of a projection for 2020 assumes a country population of 4.6 million. By assuming 100% per cent connection to a continuous water supply together with a doubling of tariffs, there is a significant net benefit to household budgets. The total annual benefits would be €282-341 million, which is equivalent to 0.7 per cent of GDP.

Table 4.8 Estimated annual benefits in 2020 of meeting the water, sanitation and hygiene targets

	Annual cases avoided				Annual monetized benefits (Million € (PPP))							
	Diarrhoea		Deaths		Morbidity		Mortality		Total		Total (% GDP)	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Algeria	7.0	16.1	1,313	3,024	442	1,018	700	1,613	1,142	2,630	0.40%	0.93%
Egypt	19.0	43.4	1,158	2,644	815	1,860	416	949	1,231	2,809	0.26%	0.60%
Israel	0.6	1.0	1	2	122	224	2	3	124	227	0.06%	0.11%
Jordan	1.5	3.2	55	119	66	142	20	44	86	186	0.24%	0.52%
Lebanon	0.7	1.6	11	24	67	150	9	19	76	169	0.30%	0.30%
Morocco	8.2	16.3	1,410	2,794	277	548	396	784	672	1,333	0.50%	0.99%
OPT	1.2	2.6	88	193	28	61	17	37	45	99	0.32%	0.70%
Syria	4.9	11.3	234	536	179	410	71	162	250	572	0.24%	0.54%
Tunisia	2.2	4.7	79	168	140	297	42	89	182	387	0.22%	0.48%
TOTAL	45.3	100.3	4,349	9,504	2,136	4,710	1,673	3,700	3,808	8,412	0.28%	0.57%

[1] Note: 'Low' represents cases avoided and benefits if the population already has good hygiene practices adequate for health protection. 'High' represents cases avoided and benefits if population hygiene practices can and will be substantially improved.

Source: Estimates by the authors.

4.3 Level of waste water treatment

4.3.1 Introduction

Waste water once collected (see previous section on sewage connection) still presents significant problems for health and ecosystems if it is not subject to appropriate levels of treatment. The level of waste water treatment is often rather poor and there is substantial room for improvement in many of the countries under study, or in parts of them. Poor waste water treatment leads to damage to the natural environment and can substantially affect water quality. For example, it is one of the key sources of pollution of the river Nile in Egypt. Health impacts are discussed under the parameter 'Connection to sewage network and hygiene conditions' as they involve the same diseases.

The following definitions apply:

- *Urban waste water:* domestic waste water or the mixture of domestic waste water with industrial waste water and/or run-off rain water. (CEC, 1991)
- *Domestic waste water:* waste water from residential settlements and services which originates predominantly from the human metabolism and from household activities. (CEC, 1991)
- *Industrial waste water:* any waste water which is discharged from premises used for carrying on any trade or industry, other than domestic waste water and run-off rain water. (CEC, 1991)
- *Waste water treatment:* any process that reduces the amount of the suspended solids, and dissolved compounds and micro-organisms harmful to the environment and/or the human health in waste water. Only treatment in facilities operating with the approval of environmental and/or health authorities should be considered. (WHO 2002)
- *Primary treatment:* treatment of urban waste water by a physical and/or chemical process involving settlement of suspended solids, or other processes in which the BOD5 of the incoming waste water is reduced by at least 20 per cent before discharge and the total suspended solids of the incoming waste water are reduced by at least 50 per cent. (CEC, 1991)
- *Secondary treatment:* treatment of urban waste water by a process generally involving biological treatment with a secondary settlement or other process. (CEC, 1991)
- *Tertiary treatment:* The process which removes pollutants not adequately removed by secondary treatment, particularly nitrogen and phosphorus; accomplished by means of sand filters, microstraining, or other methods. (EEA, undated)
- *Eutrophication:* the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned. (CEC, 1991).

4.3.2 Benefits of improving waste water treatment – qualitative assessment

The benefits of improved waste water treatment include health benefits and wider ecosystem benefits. These are addressed in more detail in the preceding and following sections respectively. These benefits also have economic and social benefits. This full range of benefits is summarised in table below.

Table 4.9 Overview of key benefits of improved waste water treatment

Health benefits	Most health benefits are related to sewage collection, rather than treatment per se, as sewage that is not appropriately collected can cause significant health problems (such as diarrheal diseases, dysentery etc.). These benefits are therefore assessed under the 'sewage connection' parameter and not here, to avoid duplication.
Environmental benefits	The increased and improved treatment of wastewater is meant to lead to a reduction in nutrient discharges and, therefore, a reduction in eutrophication in aquatic ecosystems, with due improvements to the ecosystems and associated recovery of fish and other aquatic life. It must be noted that nutrient removal does not just arise from tertiary treatment. Significant removal also occurs with secondary treatment. In Ukraine, where eutrophication represents an important ecologic problem, the environmental benefits can be significant.
Economic benefits	Many drinking water sources are derived from rivers, which receive wastewater discharges. Therefore a reduction in contaminants in the abstracted waters can bring direct financial benefits in terms of reduced costs of treatment for potable water. Moreover it can be anticipated that, thanks to increased/improved water treatment, surface water should be more suitable for economic uses such as cooling water and industrial water, and for fishery and agriculture. This will bring significant direct cost reductions to water intensive industries in particular. Furthermore, the investment in environmental technology and improvement in the skills of those working in the water industry will assist in enhancing the economic base of the country.
Social benefits	Most health benefits are related to sewage collection, rather than treatment per se, such as nuisance related to odours from direct discharge of sewage in the environment etc. These benefits are therefore assessed under the 'sewage connection' parameter and not here, to avoid duplication.

4.3.3 Benefits of improving waste water treatment – quantitative and monetary assessment

The health benefits from improved waste water treatment accrue jointly with improved sanitation. The joint assessment is provided in the preceding section. However, it is also clear that in areas that are subject to water stress, the treatment of waste water also had the added benefit of providing an additional water source for irrigation. This has not been quantified across the region (though the principle can apply anywhere). However, the following two boxes provide examples of the economic benefits to populations that result from the adoption of improved waste water treatment.

Box 4.3 Improved waste water treatment in the occupied Palestinian territory leading to improved family incomes

A project (2007-2010) installed and tested 12 sludge filtration units to improve waste water treatment in 18 villages around the Bethlehem and Hebron Governorates encompassing 180 households (around 1,800 people). Imported filtration units cost €17,175 each, while locally made ones cost €5,725 each. In addition the 180 households were supplied with suitable irrigation networks connected to the treated waste water (currently totally 180m3/day).

As a result of the improvements, untreated waste water no longer is released into the environment, so benefit local ecosystems and public health. Furthermore, the re-used water is supporting local agriculture, improving food supply and providing income. It has also helped to raise awareness of wider environmental issues. For example, agricultural production has increased from 502 kg/household/year to 722 kg/household/year. Income from food sales has, as a result, increased more than three fold.

This project has demonstrated the immediate social and economic benefits of improved waste water treatment. Success required support not only of the authorities, but also of the communities affected. It has been concluded that the lessons from the project are more widely applicable for other communities.

Box 4.4 Improved waste water quality provides irrigation water in Israel

In 2008 92 per cent of settlements in Israel with populations above 2,000 inhabitants were connected to waste water collection and treatment systems. Of the 500 waste water treatment plans, over half treated water to secondary level and a third to tertiary level. The resulting waste water is a potential valuable source of water for agricultural irrigation and currently 82 per cent of waste water is used in this way.

In order to provide for irrigation, the waste water must be treated to remove contaminants that would either affect crops directly or the people who consume them. The Government has, therefore, adopted a strict series of standards for 36 parameters for waste water to be used in irrigation. However, even so effluent water is only permitted to be used directly for non-edible crops (e.g. cotton) or, if also disinfected, for orchards. However, these are significant benefits given the levels of water stress in the country and allow for economic production where it might otherwise be difficult or need to use other expensive sources (e.g. desalinised water).

4.4 Surface Water Quality

4.4.1 Introduction

The surface water quality parameter measures the benefits derived from improvements in the level of quality status of rivers, lakes, reservoirs, transitional and coastal waters (up to three nautical miles) for each South ENPI country. This section reports on the assessment of the health, social, environmental and economic benefits to society derived from the achievement of a given policy target for surface water quality improvements by 2020. The benefits are analysed in two ways: qualitatively and, where available information allows it, monetarily, through an economic valuation of the benefits. The aim of the economic valuation exercise is to estimate the economic value of uses people in the country would make of surface water that meets the policy target by estimating what local residents would be willing to pay for the changes. The approach to valuing improvements in surface water follows that of a UK study which determined the willingness to pay of households for cleaner water. The original benefit functions of this study have been adapted and transferred to each of the South ENPI countries. Thus, allowing for the inclusion of specific contextual water quality and socio-economic information in the benefits transfer exercise.

The given policy target consists of an improvement from current conditions to the EU Water Framework Directive (WFD) target of 'Good Ecological Status'.

4.4.2 Current status in the region

Due to its arid environment, scarcity of water is the overwhelming environmental concern in South ENPI countries. Unlike other environmental issues, access to water is also a highly politicised issue in the area (e.g. Egypt): in fact, the water issue is as much a question of governing access to a valuable strategic resource as it is an environmental policy matter. Pressures on water availability tend to include population growth, growth in agricultural and industrial production, as well as general economic development. These pressures continue to put a strain on the limited water resources available, both in terms of water quality and quantity. In recent years, the existing scarcity problem has been further exacerbated by repeated drought cycles in the area (e.g. east Mediterranean region), resulting in an overuse of natural water resources beyond their natural recharge.

Inland and coastal water is also exposed to several sources of contamination, especially industrial and agricultural processes and waste water discharges, representing a real threat for development and health.

Increased efficiency in water use is a particular challenge for agriculture, which is one of the main water uses. In light of growing domestic and industrial demand, allocations of freshwater to agriculture have been declining in the region. A downside of efficiency gains in water use is that countries aim to use practically all of its renewable water sources (be it for domestic consumption, agriculture or industry). This means that hardly any water is left for environmental uses, with adverse impacts on ecosystems that depend on freshwater such as wetlands, and the flora and fauna that depend on them. Although the lack of monitoring

stations, and sometimes also lack of, or inadequacy of, national quality standards for priority quality substances (e.g. Heavy metals, BOD, COD), makes it impossible for most countries to assess the present pollution situation of their rivers, lakes and reservoirs. Eutrophication is however becoming more apparent in several countries, such as Egypt, as a result of increasing pressure of pollutants on water bodies.

4.4.3 The benefits of improving surface water quality- qualitative assessment

Water quality influences human uses of the affected resources, leading to changes in use values and non-use values of the resource. It is difficult however, to quantify the relationship between changes in pollutant discharges and the improvements in societal well-being that are not associated with direct use of the affected ecosystem or habitat. The fact that these values exist, however, is indisputable, as evidenced, for example, by society's willingness to contribute to nature conservation organisations.

An overview of key benefits derived from improved surface water quality in the South ENPI countries can be found below. Table 4.10 reflects the range of goods and services that are provided to society in these countries by a healthy water environment. Some of these benefits have been covered under other sections of this document.

Table 4.10 Benefits associated with surface water quality improvements in ENPI South countries

Health benefits	– Polluted water is a minor cause of human disease and death. – Key diseases avoided are those of the alimentary system. Microbial (both bacterial and viral) contaminants (e.g. E-coli) can cause a range of problems from mild disorders to major diseases such as dysentery. Some disease will occur from infection from regularly occurring intestinal bacteria, while others are diseases passed on from those already infected. – Treatment to remove common bacteria (such as faecal coliforms) will also destroy a wide range of more dangerous, if infrequent, bacterial diseases.
Environmental benefits	– Physical effects are translating into biological impact, i.e., eco-system damage and biodiversity loss. – The presence of pollutants/toxic substances in water (e.g., metals, pesticides), affect a wide range of animal, fish and vegetation, both freshwater and marine and are site specific in South ENPI countries (e.g. as seen in Jordan in the King Talal dam): o Species may be affected by direct toxic effects on metabolism and the disruption of endocrine functions, which often impacts on the reproductive system. o Some substance can also be accumulators both within the environment (e.g., sediments) and within animals (bioaccumulation). Therefore they can represent a significant threat even in small concentrations. – Although not an issue in most South ENPI countries, excessive nitrates concentrations can cause extensive harm to the environment through eutrophication. Nitrates greatly stimulate the growth of algae. The decomposition of such algae reduces the water's dissolved oxygen content, adversely affecting fish and other aquatic life forms. Decreases in nutrient loadings thus benefit aquatic habitats. This, accompanied by lower sediment and pesticide loadings, results in increased fish and waterfowl populations.
Economic benefits	– Cleaner surface water resources in South ENPI countries can: o reduce costs to industry (e.g. for pre-treatment),

Table 4.10 Benefits associated with surface water quality improvements in ENPI South countries	
	○ reduce costs to society by avoiding that the cost of remediation and of drinking water treatment escalates, ○ stimulate the development of new environmental technologies (e.g. for water treatment), ○ avoid microbiological contamination of food crops, ○ increase fish populations and catch in some rivers (Orontes) and in marine environment, ○ enhance the potential for tourism, ○ increase the value of property – Water pollution is both a cause and an effect in linkages between agriculture (the single largest user of freshwater on a global basis) and human health: ○ Agriculture is and is a major cause of degradation of surface and groundwater resources through erosion and chemical runoff. Measures to reduce the negative impact of agriculture can lead to improved farm practices and reduced costs. Such measures may include e.g. stimulating a more efficient use of fertilisers and pesticides. ○ Avoiding microbiological contamination of food crops, stemming from: use of water polluted by human wastes and runoff from grazing areas and stockyards. This applies both to use of polluted water for irrigation, and by direct contamination of foods by washing vegetables etc. in polluted water prior to sale. Crops that are most implicated with spread of these diseases are ground crops that are eaten raw. – Increased fish stocks and harvest: reducing pollution is expected to enhance aquatic life habitat and thus to greatly contribute to increasing freshwater and coastal fish populations. These population increases would positively affect subsistence anglers, commercial anglers and fish sellers, and consumers of fish and fish products. – The coastal bathing areas have a strong potential for tourism. An improvement in quality of bathing waters (where this is currently poor or below standards) can ensure that more tourists are attracted to the area and thus revenues for local economy are secured. – Aesthetic degradation of land and water resources resulting from pollutant discharges can reduce the market value of property and thus affect the financial status of property owners.
Social benefits	– Water pollution is affecting the quality of living in the areas nearby surface waters. – Water pollution is reducing the amenity value and tourism development benefits to local communities as this restricts the use of waters. – Improved surface water quality will favour recreational uses, such as swimming, boating, angling and outings. Improved water appearance and odour make it more desirable and visually appealing for recreation. – Pollutants can also have effects on health (see above) and therefore can place a strain on social support systems within a community and lead to a feeling of isolation of that community from the social structure of the country as a whole. – Even if no human activities are affected by water quality degradation, such degradation may still affect social welfare. For a variety of reasons, including bequest, altruism, and existence motivations, individuals may value the knowledge that water quality is being maintained, that ecosystems are being protected, and that populations of individual species are healthy completely independent of their use value.

4.4.4 Benefits of improving surface water quality – quantitative and monetary assessment

In order to achieve the aforementioned benefits, some ENPI countries have already defined their own surface water quality targets (e.g. Morocco) and are organising themselves in order to reach the objectives somewhere between now and 2020 (which is the target year for this study) or beyond.

In this study, for the transfer of benefits functions we do not consider changes in water quality management policy between now and the fixed period in 2020 but assume that existing policy is driven by the EU Water Framework Directive and the objective of no deterioration in quality and achievement of GES. The baseline scenario is the current water quality levels in the countries.

The benefits function transfer (BFT) approach from the UK study can be applied as long as one knows the percentage of freshwater units (river length or surface area for lakes) that would fall into each water quality category as used in the original valuation study. Egypt and Morocco are highlighted below to illustrate an example of the type of baseline information that has been used to feed the BFT models.

Box 4.5 Baseline water quality levels in Egypt

The river Nile extends by 1,530 km length inside Egyptian lands. It is the main source of fresh water in Egypt and more than 95 per cent of Egyptian people depend on it. Although the water quality of the Nile is considered to be in relatively good condition, major problems occur downstream. The baseline water quality information used from Egypt to feed the benefits transfer model indicates that presently 27 per cent of the river Nile length fails to achieve good ecological status according to the WFD. This is based on expert opinion as the country currently lacks an overall assessment of water quality.

There are two main lakes in the country: Lake Nasser and Lake Manzala. Monitoring results in 2009 indicated that the water in lake Nasser is of good quality (EEAA, 2010). Eutrophication is, however, a significant issue in Lake Manzala, especially close to water discharges (Mahmoud et al, 2006); and recent studies have shown a change from moderate eutrophication to highly eutrophic water (Hra 2011). For further information please see the specific country report for Egypt.

Box 4.6 Baseline water quality levels in Morocco

The table below illustrates the results of the water quality assessment for the main rivers of Morocco according to national water quality classifications. This information has been used to estimate the baselines used for the BFT model.

Rivers	Length (km)	Excellent	Good	Medium	Bad	Very bad
Bouregreg	190	0%	42%	32%	18%	8%
Loukkos	109	0%	0%	13%	39%	47%
Souss Massa	340	0%	0%	58%	29%	13%
Oum Er-Rbia	425	5%	66%	21%	8%	0%
Tensift	240	11%	24%	21%	34%	11%
Ziz-Guir & Rheris	873	24%	50%	5%	11%	11%
Sebou	400	0%	32%	13%	16%	39%
Total	2577	6%	31%	23%	22%	18%

Unfortunately, the availability of the needed background information on river and lake water quality for the construction of the baselines to feed the BFT models varies from country to country.

Countries for which nation-wide quality status assessments exist for rivers are: Morocco and Syria. For the remaining countries that do not have nation-wide assessments of water quality, baseline levels are assumed to be in the worst case scenario (100 per cent improvement needed) or rely on expert opinion.

Furthermore, nation-wide assessments of lake water quality do not exist. Thus lake water quality has not been included in the BFT models and benefits have not been monetised. This highlights that further efforts need to be placed into monitoring current water quality conditions in these countries. Further discussion on the constraints and detail of the model are provided in Box 4.7 below.

Table 4.11 below illustrates the range of monetary benefits in South ENPI countries from an improvement in water quality from current conditions to GES, which is the overarching environmental objective of the EU Water Framework Directive (WFD). The benefits function transfer (BFT) approach from the UK study can be applied as long as we know the percentage of freshwater units (river length or surface area for lakes) that would fall into each water quality category as used in the original valuation study.

The monetary benefits are equal to the estimated amount of money that households in each country of the region would be willing to pay for improved surface water quality by 2020.

Table 4.11 Benefits of meeting water quality improvement targets – South ENPI countries, 2020

	WTP results in 2020 € PPP per HH year		**Aggregated benefits WTP in 2020** (€ PPP million)		**Benefits relative to GDP in 2020** (%)	
COUNTRY	lower	upper	lower	upper	lower	upper
Algeria	41.2	188.5	283.7	1,296.6	0,10%	0,46%
Egypt	31.2	173.9	669.1	3,728	0.14%	0.80%
Israel	67.1	240.0	159.5	571.1	0.08%	0.27%
Jordan	47.3	185.4	66.7	261.6	0.18%	0.72%
Lebanon	59.6	214.4	59.4	213.6	0.13%	0.45%
Morocco	34.9	160.7	242.5	1,117.5	0.19%	0.86%
OPT	-	-	-	-	-	-
Syria	34.9	159.9	170.4	781.6	0.16%	0.74%
Tunisia	41.7	184.6	103.8	459.4	0.13%	0.57%

Source: Estimates by the authors.

Box 4.7 Further background to the use of the Benefits Function Transfer (BFT) in this project

Due to the lack of regional valuation studies on the topic, and the impracticability, due to the time and budget constraints of conducting an original valuation study, the BFT approach has been applied to estimate the total economic value of cleaner water. Unlike direct value transfer, this method allows for the incorporation of differing socio-economic and site quality characteristics between the original study site for which the original benefits estimates were obtained and the policy site under evaluation. Under this approach, typically only one original valuation study is selected. The main assumption made is that the statistical relationship between willingness-to-pay (WTP) values for improvements and independent variables are the same for both the study and policy site. In other words, the method assumes that preferences/tastes are the same for both locations and differences in WTP are only related to differences in socio-economic and/or environmental context variables.

The benefits from water quality improvements covered in this section by the application of the BFT method are related to the quantifiable portion of the total economic value of particular use and non-use types derived from the enjoyment of good water quality by local residents of the country. The specific types of water uses covered in the model are highlighted with examples in the Table below. It is important to note that it is not possible to disaggregate values for the different types of uses outlined below and that other types of water uses are valuated and assessed in other sections of this report.

Types of benefits covered with the proposed method

	Types of water uses			Example
Potential Water Quality Benefits	Current use benefits	Direct use	In Stream	Recreational activities: Fishing, swimming, boating
		Indirect use	Near Stream	Recreational activities: Hiking, trekking
				Relaxation, enjoyment of peace and quiet
				Aesthetics, enjoyment of natural beauty
	Non Use		Option	Preferences for future personal use of the resource
			Existence	Maintaining a good environment for all to enjoy
			Bequest	Enjoyment from knowledge that future generations will be able to make use of the resource in the future

Box 4.7 Further background to the use of the Benefits Function Transfer (BFT) in this project

In order to transfer the benefit functions from Baker et al (2007), the following variables have been adjusted from the original model:

- Current fresh water quality levels (information collected in-country);
- Average income levels per household (World Bank);
- Education levels (World Bank);
- Population number, Household Gender composition and Household occupancy (World Bank);
- Other socio-economic stats: GDP figures in Euro and local currency, PPP conversion factors and projections (World Bank).

Due to the uncertainty around transferring values across quite different contexts, including the assumption that differences in WTP are only related to differences in socio-economic or environmental context variables, the findings should be treated as fairly rough estimates. Results are shown in a range to illustrate the degree of uncertainty associated with the benefits estimates. The following are important aspects to take into consideration when making use of the results reported above: 1) only people residents in these countries are considered. Any possible value that visitors to the country may put on the overall quality of water resources is not accounted for in this method; 2) values have not been separated by types of uses of water, use (e.g. recreation) and non-use values (e.g. those derived from the enjoyment of good water quality) are included in the analysis.; 3) the analysis illustrates a portion of the TEV of water quality improvements, only valuation of people's preferences for changes in quality are included here, other chapters in this synthesis report illustrate other types of values, including direct use market values; and 4) it has been assumed that all water bodies in each country have the same value. This assumption becomes important when considering that values for some water bodies may be higher if they are of significant importance (for example for cultural reasons) or if water resources are scarce. Values may also decrease when overall water quality in the country increases as a result of the improvements.

In conclusion, the potential benefits of improving surface water quality in South ENPI countries can be expected to be considerable. To achieve these benefits there is:

- The need to set long term water quality targets and objectives for the protection of water resources. No action implies a loss of significant benefits to society in these countries.
- The need to establish and improve current surface water quality monitoring capacity in order to accurately depict baseline status and assess distance to target.
- The assessment of benefits derived from water quality improvements can be used to justify policy action and the required investment to achieve the improvements.

4.5 Water resource scarcity

The ability to secure a sustainable water supply is one of the greatest challenges facing society today worldwide. This issue is particularly acute in the ENPI South countries. Attempting to create a balance between the needs of people and the pursuit to continue economic development has created a situation where water resources are increasingly at risk from climate change related impacts, over abstraction and continued political instability.

4.5.1 Introduction

The concept of scarcity is considered relative, that is, the imbalance between supply and demand varies according to local conditions. However, water scarcity is fundamentally dynamic and intensifies with increasing demand and decreasing quantity and quality. There is often a trade-off needed to manage the water demands of various sectors including agriculture, industry and public use with the environment, which can be achieved through the development of an integrated resource water management plan.

The European Environment Agency (2009) measures stress on freshwater resources as the Water Exploitation Index (WEI). It is suggested that countries should, where appropriate, aim to lower their WEI towards 20-40 per cent. A reduced WEI should allow more water to be available to maintain and enhance wetlands and water bodies with improved biodiversity and ecosystem services.

Diverse landscapes, changing climates and varied regional and national initiatives influence the type and level of response to the issue. The challenge of managing water scarcity is further complicated by economic and political instability and the requirement of sustainable partnerships between countries that share both political boundaries and resources (FIIA, 2010)[1].

4.5.2 Current status in the region

Water scarcity is a fact of life for much of the ENPI South region and preservation of water resources in one of the major challenges for the region today. Some countries, like Egypt, live below the international water poverty line of 1,000 m^3/capita. In Syria water scarcity is one of the most acute issues, with inflows from riparian countries expected to decrease over the next years and the future water demand expected to increase. Morocco's water resources are becoming increasingly scarce in some areas as a result of population growth, pollution, inefficient irrigation, irregular rainfall and sedimentation of reservoirs. Impacts of climate change, such as higher temperatures and lower levels of rainfall are already evident and leading to increased evaporation and higher levels of groundwater salinity. A number of other factors are exacerbating water scarcity in the region, including: severe droughts, regular flooding, inefficient irrigation techniques, fast growing population, desertification, large network distribution losses and high costs to implement new technologies such as desalination. To continue to meet the population's water needs under increased water scarcity, sustainable water management policies, related to both quantity and quality are essential.

Key water scarcity statistics for the region are summarised in Table 4.12 below. However, it is important to note that these are aggregated data for countries as a whole. The table reveals that overall the average WEI of 67 per cent, but that it reaches over 90 per cent in Jordan, Israel and Egypt. Lebanon appears to be the least water stressed with a WEI of 29

1 Finnish Institute of International Affairs (FIIA) (2010) *Managing Blue Gold New Perspectives on Water Security in the Levantine Middle East*

per cent. Agriculture is by far the greatest user of water (66 per cent of use on average), followed by municipal use (27 per cent), and industrial use only at 7 per cent.

The region continues to experience significant political unrest, which is likely to hinder the development and implementation of effective water related policy. Increased abstraction upstream has dramatically reduced river flows in some areas, and led to some surface waters in the region being the most contested in the Middle-East.

Water scarcity in the Middle-Eastern countries appears to be better understood and documented, whereas limited information appears available for North Africa. Figures for 2020 have been estimated for Israel, Jordan Lebanon, OPT and Syria, and predict increased population and economic development, coupled with decreased water availability despite ambitious plans to promote best practices in agriculture and implementation of new water-saving technologies. Projections for future water use must be considered and based on water sharing assumptions with riparian countries and advanced climate change modeling for the region.

Israel remains an exception in the region, with some of the world's most advanced water management standards, administrative tools and economic incentives. In the last decade significant improvements have been made to change the national agriculture production and trade structure to increase the production of water efficient crops and decrease inefficient ones. Even with the implementation of new technologies and ambitious plans to reduce scarcity by 2020, water scarcity remains a major issue for Israel.

Water scarcity issues are exacerbated by poor public and private actor performance in many countries of the region (Doumani, 2007). For example, public utility performance in major cities is poor with large variations among countries. Most public sector urban utilities show water losses ranging between 30 and more than 60 per cent. Furthermore, the agriculture sector has unfortunately little incentive or has rather disincentives (subsidies or cross-subsidies especially on energy) for water conservation and efficiency. Water Services are, for most countries, characterized by (Doumani, 2007):

- Inadequate governance (accountability, planning, financing, organizational capacity, etc.) affecting both access and water-related diseases;
- Poor utility performance (water losses between 30 and 60 per cent) and less than full recovery of operating costs; and
- Low agricultural water requirement ratio that measures the agricultural efficiency and ranges between 0.3 and 0.5 per cent.

4.5.3 The benefits of reducing water scarcity- qualitative assessment

Reducing water scarcity and optimising overall water use across the region can have a multitude of environmental, economic, health and social benefits. However, due to the complexities of water management issues and budgetary constraints, this study was not able to evaluate the monetary benefits of improved water resource management in general, except in some countries where data were readily available (see Box on Syria below). Instead, an overview of associated qualitative benefits is provided below.

Box 4.8 Benefits associated with addressing the pressing water scarcity in Syria

Considered a severe water stressed country with 843 m^3 per capita in 2009, Syria water resources are ineffectively and inefficiently managed with the bulk of water resources allocated towards irrigation. Syria reached peak renewable fresh water years ago with successive severe droughts over the last years that are increasing their toll on the quality of life and livelihood of notably the north-eastern population. Syria is highly dependent on water inflows from riparian countries and climate change affects will reduce the flows by ±20% by 2020. Therefore, Syria needs to supplement its available resources through any means possible hence fulfilling its imperative sovereign obligation to provide enough water to sustain life and the livelihood of the population.

The marginal substitution volume to compensate for peak renewable fresh water by 2020 is suggested to represents 60% of the 7 billion m^3 deficit equivalent to 4.2 billion m^3. This supply augmentation relies exclusively on water desalination and the cost of desalination is considered in this particular case the benefits although conservative accruing to society. Collectively, the value added health, environmental (a desalination impact assessment should duly be addressed), economic and social benefits are actually much higher (sustain life, prevent water-borne diseases (quantity), reduce migration, etc.) than the desalination cost per m^3.

The conservative monetisation of benefits ranges between €2.4 billion (PPP) and €4.3 billion when using the 2020 desalination production cost, which is equivalent to 3.2 per cent of 2020 GDP.

Freshwater ecosystems can benefit from improved environmental flows (i.e. water levels), which can in turn help restore natural habitats and reduce pollution concentration as well as the associated impacts from this. A shift towards more water efficient crops and trade restructuring, along with improved irrigation techniques and application of best practices can improve agricultural outputs and help reduce water-related risk for agricultural producers. Poor water management practices coupled with incidences of drought can result in significant economic losses from crop failure.

Table 4.12 Water Scarcity Statistics in ENPI South

Country	Total actual renewable water (TARWR)	Amount of surface water from neighbours	Total water use				Water exploitation index	Water available per capita	Total water use per capita	Municipal water use per capita
	km^3/year	%	Agriculture (%)	Municipal (%)	Industry (%)	Losses (%)	%	m3/person/ year	m3/person/ year	m3/person/ year
Algeria	12	4%	65%	22%	13%	-	52%	340	180	40
Egypt	70	150%***	86%	9%	2%	3%	97%	860	830	80
Israel	2.1	55%	57%	37%	6%	-	95%	300	280	110
Jordan	1.0	27%	65%	31%	4%	-	91%	174	159	49
Lebanon	4.6	0%	60%	29%	11%	-	29%	1090	310	90
Libya*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Morocco*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OPT	0.85	17%**	45%	48%	7%	-	49%	240	120	60
Syria	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia	4.6	9%	84%	12%	4%	-	57%	450	260	40
Average	*14*	*19%*	*66%*	*27%*	*7%*	-	*67%*	*493*	*306*	*67*

Source: FAO 2005 plus other more recent data from country reports

**Information for these countries was not available at the time this report was written.*

***% surface water from Israel*

**** Due to the high water flow from other countries and the limit on water use due to conventions on Nile Water.*

Implementation of desalination and water reuse schemes has the potential to stimulate local economies by providing new jobs and opportunities to expand tourism. In a region that experiences significant areas of economic deprivation, these schemes have the potential to improve living standards for many citizens.

The region is home to some of the world's most important water systems in terms of cultural and spiritual significance. Improved access and conservation can enhance tourism in the region and ensure preservation of religious heritage.

Improving water resource management will also help deal with the implications of climate change which could, as outlined in the Box below, have significant impacts on agriculture. Additional adaptation strategies may help minimise the potential adverse consequences.

Box 4.9 Water resources and agriculture sector - vulnerability and adaptation in Lebanon

Water resources will be affected by climate change with lower precipitation and spatial and temporal (main precipitation will occur in November and December) projected changes that will be exacerbated by evapotranspiration and droughts. A reduction of 6 to 8 per cent of the total volume of water resources is expected with an increase of 1°Celsius and 12 to 16 per cent for an increase of 2°Celsius.

The main adaptation measures of the water sector include: (i) the protection of groundwater from salinisation in coastal areas; (ii) the implementation of water demand side management strategies to reduce domestic, industrial and agricultural water demand; (iii) the development of watershed management plans; and (iv) the implementation of pilot initiatives to demonstrate the feasibility of alternative sources of water supply such as water reuse and develop necessary standards and guidelines.

Agriculture will be hard hit by higher temperatures, reduced precipitation and higher evapotranspiration. The combination of these factors will decrease soil moisture, increase aridity, and increase infestation of fungi and bacterial diseases, which will all affect overall agricultural crop yields. Some plantations will have to be shifted from the coast to higher altitude, e.g., bananas and tomatoes. Irrigated crops will face water shortages and the productivity of rainfed crop will decrease in certain regions. The gazing period and the quality of the pastures will be affected by rising temperatures and less rainfall.

The main adaptation measures of the agriculture sector include: (i) the selection and introduction of more drought and heat-resistant species and hybrids; (ii) the change in planting dates and cropping patterns; (iii) the adoption of sustainable agricultural practices and integrated pest management techniques; (iv) the elaboration of a national rangeland program; (v) the enhancement of genetic selection of local breeds; and (vi) and the promotion of mixed exploitations.

Source: Lebanon Second Communication to the UNFCCC (2011)

Overall, the analysis has highlighted that water scarcity and management is a critical issue in ENPI South countries. However, it is worth noting that there may be considerable differences in availability and use of water between localities within a country. Over the past decade, considerable progress has been made in the region to tackle water scarcity.

However, this challenge is changing as the impacts from climate change in areas surrounding the Mediterranean intensify and population in the region continues to increase. Reforms to integrated water resource management must be planned and implemented with these challenges in mind and noting the realities of the political economy [1]. Tackling these problems will promote proactive climate adaption strategies to be in place and help sustain levels of water use.

Technologies aimed at reducing water scarcity need to be further considered using a holistic life cycle approach to ensure that water savings in one part of the value chain do not shift sustainability burdens to other parts of the value chain (i.e. further upstream or downstream) or have adverse effects on other issues (i.e. increased energy use). Currently, desalination is considered a viable, albeit costly, option to improve water resources; however, critics note that the large amounts of energy use, marine damage and associated emissions to soil and water may have serious implications.

Some country analyses assume domestic water demand to increase in line with population and agriculture and industrial growth to generally increase, but this is uncertain. Also projected growth for domestic, agriculture and industry water demand is not readily available making it difficult to accurately project future needs. Potential changes related to an increased number of households connected to mains or reduced water use that may be achieved through new or higher tariffs, increased awareness or improved infrastructure could influence these estimates. In addition, climate change is likely to bring changes to temperatures and precipitation patterns, which could change the reliance on current systems such as irrigation, and should be explored in more depth.

Tackling these issues in a holistic manner is essential, through consideration of both supply and demand issues. This is best achieved through developing integrated water resource management plans and promoting the creation of proactive strategies to help sustain levels of water use. Enhanced integrated water resource management and a better understanding of associated economic values to optimise overall economic, environmental and societal benefits is strongly recommended.

4.6 Conclusions – Water related benefits

Poor provision of drinking water quality, poor surface water quality, inadequate supplies of water and poor provision of waste water collection and treatment all present significant challenges to many of the countries of this region. In all cases, tackling these problems would deliver significant environmental, social and economic benefits.

Diseases arising from poor drinking water are a major cause of ill health. The level of provision of centralised or improved drinking water supplies in the region varies significantly, particularly for rural areas. Sewage once collected requires treatment and in some cases the infrastructure is so old that it has ceased to function. In any case, the

(1) The World Bank (2007) *Making the Most of Scarcity Accountability for Better Water Management in the Middle East and North Africa*

provision of such treatment has been limited in scope and in degree of treatment. However, it must be noted that some investment has improved treatment is a few limited cases.
All of these factors, if addressed, would improve health. Meeting targets of full connection to piped drinking water and sewage collection would mean an additional 45 million people would have reliable and safe piped water to premises, and an additional 92-106 million people would have connection to a sewage network system in 2020. Overall, across the region, the benefits that would accrue from improved drinking water quality, sewage connection, and improved hygiene practices would be between 45 million and 100 million annual cases of diarrhoea avoided and between 4,350 and 9,500 deaths avoided in 2020. The annual monetised benefits that would accrue from improved drinking water quality and sewage connection and improved hygiene practices would be between €2,136 million and €4,710 million for morbidity, between €1,673 million and €3,700 million for mortality, which would give total annual benefits of between €3,808 million and €8,412 million. These benefits represent between 0.06 per cent and 0.99 per cent of the GDP of individual countries in 2020.

Surface water quality varies, with many water courses suffering from pollution, often from old or inadequate wastewater treatment infrastructure, sewage discharges, industrial pollution, and agro-chemical run-offs. Improving this would bring significant benefits for residents and users, such as fishermen, property values, etc. The benefits of meeting water quality improvements vary between €31 and €240 per household per year, which corresponds to 0.10-0.86 per cent of the GDP of individual countries in 2020.

Water scarcity is a serious problem across ENPI South. Droughts cause significant economic damage and better water management would bring additional economic, as well as social and environmental benefits. Therefore, improving their management (e.g. through water efficiency measures) would have benefits.

It is, therefore, important for the countries of this region to ensure that the benefits of improved water management are integrated into future investment decisions. Infrastructure for water treatment or collection/distribution can be costly, but the benefits can be significant. It is, therefore, necessary for countries to improve their data gathering and assessment of the status and impacts of water quality, health, social and economic impacts to refine these analyses to improve decision making.

The countries should also set long term water quality targets. A lack of action implies a loss of significant benefits to society in these countries. However, to take this forward also requires a need to establish and improve current surface water quality monitoring capacity in order to accurately depict baseline status and assess distance to target.

The benefits arising from improved water management need to be integrated into policy and practical decision making so that investment and management decisions can be made that will deliver wide positive environmental, social and economic outcomes.

5 WASTE

Key messages - Waste

- Municipal waste collection coverage is a significant issue in most ENPI South countries, none of which succeed in reaching full waste collection coverage, especially in rural areas. Better coverage would avoid wild tipping or landfilling in unmanaged dumpsites, burying, burning of waste, and the related impacts on health and environment. Jobs can be created as well as more viable living conditions.
- A shift from dumpsites to well managed sanitary landfills – including the rehabilitation of abandoned quarries- would have a considerable environmental and social/health impact. Sanitary landfills avoid nuisance, odour, fires and smoke (often with dioxin emissions), runoff water impacts, soil contamination, and health risks (e.g. from avoided methane emissions to nearby dwellings)
- Recycling reduce the need for building new landfills and hence making land available for other uses, generates jobs and makes material resources available for the industry. Sorting at source and adapted collection systems are the first condition to reach high quality recycling. The present informal recycling sector, which is very prominent in countries like Egypt, can be professionalised and its activities can grow considerably, guaranteeing better work conditions and reduced health risks for workers
- Back-yard composting and capital extensive (windrow) composting of source separated material is a good solution to divert biodegradable waste from landfills, and it creates a valuable material to fight soil degradation.
- Biodegrading wastes cause the production of methane, a strong greenhouse gas, which escapes from landfills and dumpsites. Avoiding these emissions through enhancing collection coverage and diverting biodegradable waste from dumpsites and landfills is the first and major measure to take when addressing greenhouse mitigation measures in the field of waste policy
- Complementary methane can be captured on well equipped landfill sites. Captured landfill gas can be flared (oxidising methane to CO_2 and reducing its impact with a factor 25), or it can be used to generate electricity or to be distributed as natural gas.
- Calculable and monetisable benefit assessments can be made on: surface of avoided dumpsites, amounts of supplementary collected municipal solid waste, amounts of supplementary composted or recycled waste, jobs created for collection and waste treatment, overall value of supplementary sound waste management, based on WTP, and marketable values of avoided CO_2 eq. emissions.
- Enhanced waste coverage will likely lead to significant avoidance of polluted land –

Key messages - Waste

this first ENPI wide estimate suggests that this could be in the order of a 100 thousand m^2 for from the occupied Palestinian territory to 350,000 in Jordan to millions of m^2 in other countries - 2 million m^2 in Morocco, 3.4 million m^2 in Algeria and around 7.5 million in Egypt.

- Increased waste treatment by expanding collection coverage and sanitary landfill capacity could avoid around 35.6 million tonnes of unsanitary waste dumping, lead to 13 million tonnes of additional waste recycled or composted and eight thousand additional jobs generated in the region for landfill, recycling and composting
- Overall around 34 million more people could benefit from increased municipal waste collection coverage under the target, leading to around €1.5 billion (PPP) benefits per year for the region.
- There are considerable potential benefits from improved waste management also for climate mitigation. Over the region around 5.5 billion m^3 of methane could be avoided per year, with a value of around €5.3 billion per year from 2020.

5.1 Overview

Waste is major environmental and health issue that requires urgent attention from decision-makers in several ENPI Southern countries. Not only municipal solid waste (MSW) poses a significant problem, but also industrial waste and hazardous wastes (e.g. infectious medical waste) require due attention.

This report focuses on MSW collection and treatment. Waste prevention is a key factor in EU waste management policy, and should be a key factor in any waste management strategy. However, for methodological reasons the benefits of waste prevention have not been assessed under this project

5.2 Current status of waste management in the region

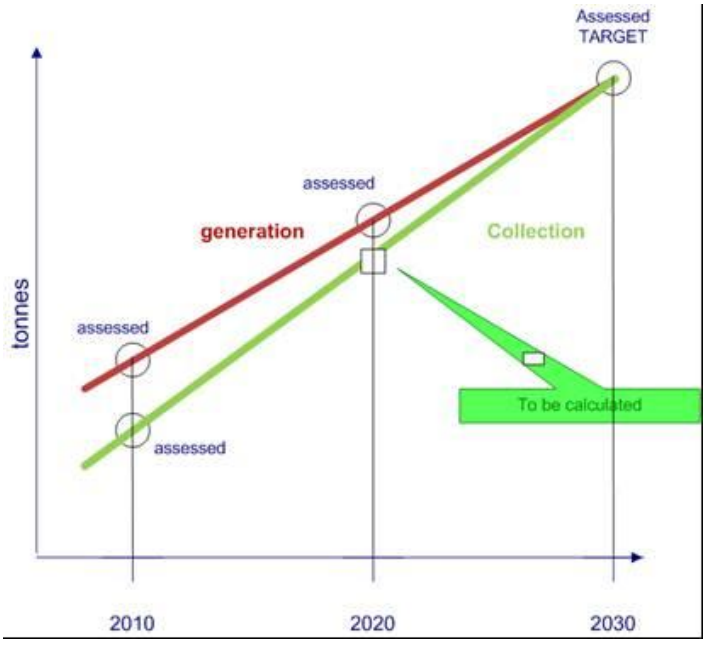
In ENPI South countries, the generation of domestic and industrial waste is increasing rapidly due to a large and continued population growth, urban expansion and economic development. Waste collection services are not covering the population of the whole countries. Some parts of the urban population are not served, and the coverage of rural areas is much lower. Where collection rates are low, wild dumpsites arise and widespread littering of natural landscapes and cultural sites occurs. Coupled with wild burning, this results in a negative impact on human health and the environment. Especially in water-stressed southern Mediterranean countries the impact of wild tipping and of non-managed dumpsites on the scarce surface water reserves in oueds and rivers can be worrying (see Box 5.1 on definitions).

Considerable amounts of waste is dumped or burned in a non controlled way. If no further collection and treatment capacity is developed, this amount will increase further.

Nearly all collected MSW is sent to landfills, as in several countries incinerators and recycling facilities are not fully developed. Most landfills (which are often wild, uncontrolled dumpsites) fail to meet basic environmental requirements and are a significant source of air pollution (due to gasses, dust and bad odour), groundwater pollution (through leachate) and surface water pollution (through runoff). Littering increases the risk of diseases and parasites spreading. Illegal scavenging is an issue, with health and safety risks for the scavengers. The lack of a sound waste management system is problematic, not only from environmental and economic reasons (e.g. reduced tourism potential due littering on beaches), but also from a health point of view.

With targets for 2030 of 100 per cent coverage of waste collection, 0 per cent illegal dumping or burning, 50 per cent recycling of glass, paper, plastics, metals, 70 per cent recycling of construction and demolition waste, 65 per cent of biodegradable waste diverted from landfills, considerable benefits can be reached. Although the ambitious targets are set at 2030, we calculated the benefits for 2020. We do not assume that these targets would be met in 2020, but we assume a linear evolution towards reaching the targets in 2030. In theory, for each year between now and 2030, the benefits can be calculated. We choose 2020 to be in line with the other environmental topics and parameters covered in this report.

Figure 5.1 Relation between basic year, target year and benefits year, example for collection coverage



Source: Authors

Box 5.1 Definitions – waste management

Dumpsite = non managed site where waste is dumped without or with only a limited site management. To be distinguished from (sanitary) landfills. Dumpsites can be large scale fly-tipping sites for non collected waste or they can be sites where waste is dumped by the collector after municipal waste collection.

Incineration = thermal destruction of waste in dedicated installations equipped with flue gas treatment, or co-incineration in energy plants or cement kilns working at comparable environmental conditions. To be distinguished from wild or uncontrolled occasional burning of waste.

Landfill, or sanitary landfill = disposal in managed sanitary landfill sites with a least an impermeable bottom liner, leachate capture, daily coverage, fencing and permanent staff. To be distinguished from unmanaged dumpsites.

Municipal solid waste (MSW) = waste collected by services for the collection of household waste. It may contain waste from small enterprises or municipal services collected in the same collection scheme. Large quantities of construction and demolition waste and end-of-life vehicles are excluded even if generated by households. Industrial and agricultural waste is excluded as well.

Oued = River in Northern Africa and semi-desert regions with a short hydro period and very irregular hydrological regime.

Recycling = making a usable non-waste product out of waste. The recycling process does not stop at the level of pre-treatment (e.g., sorting out) but ends when the waste is used as a raw material to make a non waste product.

Waste = everything one discards, intends to discard or is obliged to discard (definition in line with the EU Waste Framework Directive). Included is waste destined for recycling, even after a pre-treatment step. Excluded is clean soil, manure, nuclear waste. Economic value is no criterion to include or exclude something as a waste.

Where waste is collected, it is however generally not separately collected, which reduces the opportunities for recycling. In several countries central composting facilities are not in place, and only a minor fraction of the collected MSW is being recycled.

However, in the informal recycling sector, waste pickers recover valuable waste items before collection or at the landfill sites. For example, in Morocco it was estimated that in 2008, about 3,500 waste-pickers, 10 per cent of which were children, were living on and around the 300 uncontrolled dumpsites, and open dumpsites. Waste pickers inclusion initiatives are now being taken into account in some countries, like Morocco and Egypt.

A better collection would lead to considerable surfaces of illegal landfill avoided, and considerable supplementary jobs created for waste collection. Better waste management will generate as well supplementary jobs. Collection and treatment together are assumed to have a willingness to pay value of 1 per cent of the income of deserved inhabitants. Finally landfill diversion and recycling or composting of biodegradable waste will led to supplementary benefits, such as availability of raw materials, soil improvement, avoidance of landfill emissions and nuisances etc.

Through improved waste management national and local authorities can have great potential influence on improving the quality of public health (e.g. by improving collection and treatment), conserve natural resources (through increased recycling) and mitigate climate change (through methane capture). This would require a change of existing waste practices and the implementation of strategies aiming at waste prevention, separate collection, recycling, composting and waste treatment before final disposal. Improved waste management will generate jobs and income, with recycling generating considerably more jobs than landfilling or incineration.

5.3 Qualitative benefits of improved waste management

The benefits of a sound waste management system expand beyond keeping the day-to-day living environment clean and tidy. Waste management generates health, social, environmental and economic benefits, related to improved environmental (air, groundwater and surface water) quality, a more attractive environment and landscape, safeguarding the tourism potential, reduced CO_2 eq. emissions and climate change, energy production, availability of secondary raw materials from the recycling industry and prevention of primary resource depletion. A sound waste management system results in social benefits related to an improved environment to live in, better health and job creation.

The main benefits are included in the table below:

Table 5.1 Benefits associated with surface waste management improvements

Health benefits	– Health benefits through avoided birth defects and various diseases:
	  – including cancers, asthma, respiratory diseases, that can be caused by exposure to hazardous emissions from substandard landfills, open burning and substandard incineration.
	  – resulting from ingestion of contaminated water or food.
	– Health benefits through avoidance of occupational injuries resulting from substandard waste collection, transport and treatment
	– Health risk prevention from dumpsite gleaning
	– Food safety protection against foraging herds of sheep or goats on dumpsites.

Environmental benefits	– Waste prevention leads to fewer natural resources used. It takes natural resources to produce waste, and waste is a loss of natural resources. Waste generation thus contributes to the overall depletion of valuable natural resources. – Environmental benefits resulting from avoided pollution: dumpsites are a significant source of pollution for soil (direct soil pollution, waste getting buried), air (biodegradation gasses, dust, bad odour, toxic emission from dumpsite burnings), groundwater(through leachate) and surface water (through runoff or through flooded dumpsites in or near river beds). – Substandard landfills and dumpsites emit primarily methane and CO_2, resulting from the decomposition of biodegradable waste, a major greenhouse gas (GHG) of concern for climate change. Sound waste management can contribute significantly to GHG reduction. – Recycling reduces the amount of waste that must be deposited in landfills. – Recycling is far more efficient, in terms of energy consumption, than producing something out of new raw materials. The greenhouse gas benefit of recycling is a

Table 5.1 Benefits associated with surface waste management improvements	
	reduction in emissions from the use of fossil-fuel energy in the extraction and manufacture of products from virgin materials versus secondary materials. There is a difference in energy/electricity use for the production of material from virgin inputs (i.e. from extraction of feedstock to manufacturing) versus recycled inputs (i.e. from collection to manufacturing). – Another greenhouse benefit of recycling, relates to the avoided methane emissions of degrading paper. Composting and diverting other biodegradable waste from landfills, results in less GHG emissions.
Economic benefits	– Benefits from availability of secondary raw materials. If waste is not being properly collected and recycled, waste generation is a loss of resources. – Recycling saves resources. For example, recycling newsprint, office paper and mixed paper saves trees; recycling of steel saves irons ore, coal and limestone. – In general recycling prevents environmental impact of mining or other raw material production ; recycling does not only conserves resources, but also reduces the need for natural resource extraction and reduces thus the impact of extraction, within the country or in other parts of the world. – Flee-tipped waste and litter causes direct impact on the local economy: through its effect on the quality on agricultural land, on touristic potential, by choking sewage and irrigation systems, by damaging infrastructure. – Recycling promotes energy efficiency, which reduces energy costs. recycling is far more efficient, in terms of energy consumption, than producing something out of raw materials. – Trading in emission reductions via the Kyoto mechanisms can make landfill gas capture economically viable, – Landfill gas capture and recovery generates a supplementary energy source, available for e.g. local communities adjoining a landfill site. – Development of waste management industry. Private-sector participation, through local private companies, could be appropriately used to improve the efficiency of waste management systems.
Social benefits	– Littering and illegal dumping reduce the quality and attractiveness of the landscape. – Waste management can generate jobs and income. It represent an opportunity for those already involved in the informal recycling system that could be integrated in a more formalized system, and potentially stimulate the creation of new SMEs. Extended waste collection, shifts from dumpsites to managed landfills, incineration and the recycling industry generates a considerable number of jobs. – Communities living near dumps must bear with dust, litter, odour, insects and rats, which affects quality of life. – Noise related to the collection and transport of waste, can also be a public nuisance. – Sound waste management, in particular recycling, builds community and raises environmental awareness, here citizens get together around the common cause of better waste management and a cleaner environment.

5.4 Waste collection coverage

5.4.1 Introduction

The major environmental challenge and pressure for the region consists of expanding the collection coverage both for urban and rural population. It can be observed that not all citizens benefit from centralised waste collection services. Especially in rural or less densely populated areas people are often deprived from a collection system set up by its municipalities, and have to take care of their municipal waste themselves. This leads to wild tipping, using non controlled dumpsites, self burning or burying of all kinds of municipal waste. Although the degree of reuse can be very high and inventive in non covered rural areas, the on-going shift in consumption patterns (e.g. the widespread use of plastics or of hazardous substances…) can cause problems even in an agricultural subsistence economy, problems that did not occur in a pre-industrialised world where waste could be easily managed by traditional means.

5.4.2 Benefits of improving waste collection – quantitative and monetary assessment

Expanding the collection coverage to 100 per cent in 2030 (see page 72) generates several benefits. The following benefits have been calculated under the project, for the year 2020:

- Avoidance of land being polluted by wild tipping or non-managed waste dumpsites, assuming that all waste collected is disposed at least in sound landfill sites that meet essential environmental requirements.
- Job generation by supplementary waste collection, these jobs are directly generated by increased collection efforts. Fees are to be paid by the public service providers of waste collection and will be paid to often semi- and unskilled workers. This generates a considerable social benefit. Supplementary jobs linked to increased recycling and improved disposal are included in chapter 3.4.

Table 5.2 Quantitative and monetary benefits from improved waste collection

	Quantitative		Monetary
	m² of polluted land avoided	Nr of jobs generated	Fees generated
Morocco	1,942,529 m²	1,430	€11,005,280 PPP
Algeria	3,424,872 m²	2,520	€47,202,120 PPP
Tunisia	1,696,989 m²	1,249	€17,403,566 PPP
Egypt	7,678,698 m²	5,651	€65,630,714 PPP
Israel	No benefits ; full collection coverage already reached		
OPT	140,498 m²	1,601	€7,303,762 PPP
Jordan	361,599 m²	266	€3,226,846 PPP
Lebanon	No benefits ; full collection coverage nearly reached		
Syria	743,408 m²	547	€5,145,629 PPP
Total	15,988,593 m²	13,264	€156,917,917 PPP

Expanding the collection coverage is the first step towards better waste management, but it is not sufficient. Non-collected waste is always disposed of in substandard ways, either by

dumping, burying, incineration in a non controlled way. However, a large fraction of waste that is collected still is dumped, by the local authorities, on a non-managed dumpsite. Expansion of the waste collection coverage should therefore go hand-in-hand with the expansion of sound waste treatment, recycling and disposal capacity.

5.5 Waste treatment

5.5.1 Introduction

The main waste treatment option for collected municipal solid waste consists of dumping in a non controlled dumpsite, or disposal in a sanitary landfill. The transition from dumpsites to landfills equipped with an impermeable bottom liner, leachate capture, daily coverage, fencing and permanent staff, is far from completed in most ENPI South countries. Recycling, composting and incineration of MSW are currently underdeveloped, although most countries are aware of their importance and attempting to improve these practices. For instance, Lebanon is considering implementing waste-to-energy plants, and other countries, like Algeria and Syria, are making efforts to increase recycling.

The primary target is to avoid non-controlled waste dumping, and to replace it by disposal in sanitary landfills. Supplementary targets have been defined under the project, based on European Union targets for recycling of specific waste fractions, and for landfill diversion of biodegradable waste. The recycling targets are applicable on the amount of waste being generated in 2030, and the landfill diversion target, to be reached in 2030, is based on a percentage of biodegradable waste being generated in 2010. The target year is set at 2030, because of the ambitious character of the targets. It has been calculated though to what degree these targets will be approached in 2020.

5.5.2 Benefits of improving waste treatment – quantitative and monetary assessment

The environmental benefit consists of avoided dumping and increased recycling or composting of waste. This leads to societal benefits in the fields of environmental and health impact reduction, resource savings and quantifiable job creation.

Table 5.3 Quantitative benefits from improved waste treatment: avoided dumping, increased recycling and composting and job creation

	MSW generation in 2020 (tonnes)	Avoided waste dumping, both by expanding collection coverage and sanitary landfill capacity (tonnes)	Supplementary recycled or composted waste (tonnes)	Supplementary jobs generated, for landfill, recycling, composting
Morocco	9,298,610	2,548,680	1,336,231	618
Algeria	22,300,723	5,379,945	2,619,401	1,299
Tunisia	10,724,875	2,254,226	1,502,554	545
Egypt	44,402,057	18,788,668	4,089,588	3,828
Israel	7,792,090	185,469	734,212	117
OPT	2,691,853	1,010,165	421,320	244
Jordan	3,608,856	1,240,270	699,214	354
Lebanon	2,148,429	378,104	143,107	91
Syria	9,623,972	3,821,586	1,521,189	942
Total	112,591,465	35,607,113	13,066,816	8,038

The major environmental challenge consists of developing (low capital intensive) alternatives for dumpsites, developing sanitary landfill capacity and recycling and composting capacity.

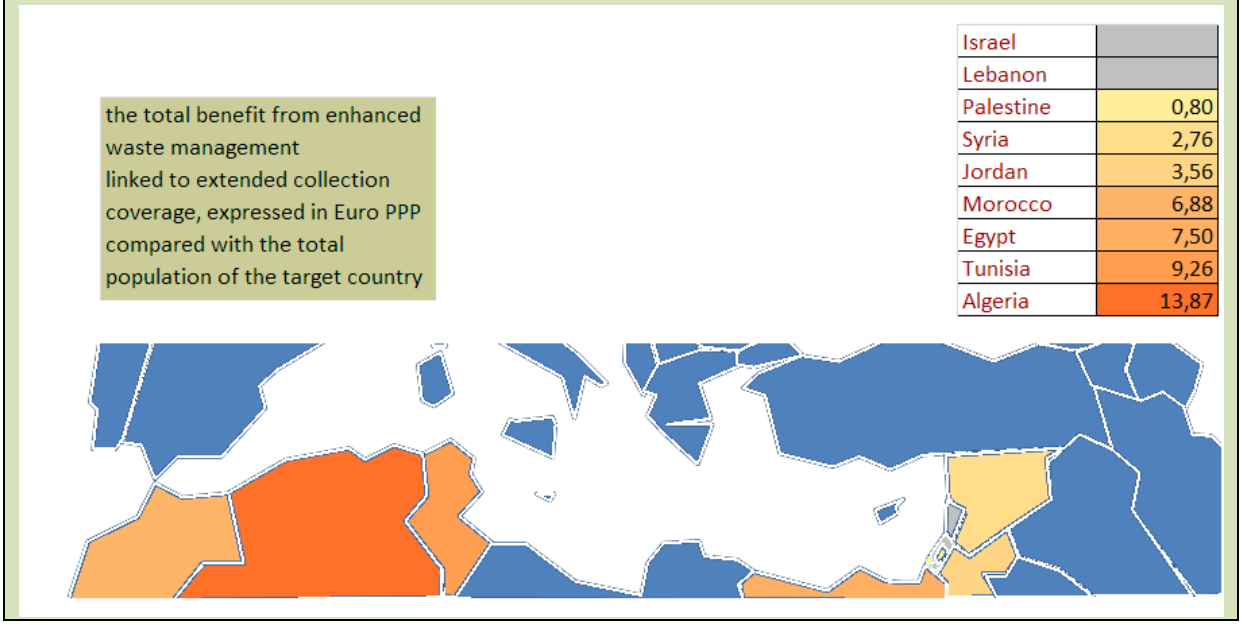
People are prepared to pay for sound waste collection and treatment, when they trust in the disposal and recycling quality and when they experience the environmental and social benefits of better waste management. The willingness-to-pay is assumed to be 1 per cent of the total household income. When taking into account the number of inhabitants supplementary served with sound waste collection and treatment, the following benefits for society can be derived.

Table 5.4 Quantitative and monetary benefits from improved waste treatment: benefits to society

	Quantitative	Monetary
	Number of people supplementary served	Societal benefits generated in million €
Morocco	7,569,791	€217,404,397 PPP
Algeria	6,041,717	€476,691,471 PPP
Tunisia	1,871,200	€95,674,456 PPP
Egypt	16,311,338	€611,512,061 PPP
Israel	No benefits ; full collection coverage already reached	
OPT	288,711	€3,155,611 PPP
Jordan	536,899	€21,046,441 PPP
Lebanon	No benefits ; full collection coverage nearly reached	
Syria	1,800,000	€56,862,960 PPP
Total	34,419,656	1,482,347,397

Box 5.2 The size of achievable benefits for enhanced waste management, compared between the ENP(I)-South countries

The value of extending waste collection and treatment over a number of inhabitants in 2020, in line with the target of reaching 100% coverage in 2030, can be expressed in a total value in € PPP. To make these figures relative, and to enable benchmarking between countries, we divided this number by the total size of the country expressed in total numbers of inhabitants. Most value can be realised, in relative terms, in Algeria, Tunisia and Egypt, least in the occupied Palestinian territory and Syria, and in the two countries Israel and Lebanon where already full waste collection coverage is reached. But in absolute values the benefits are in any case quite considerable, as clarified in the table and figure
below.



Shifts from dumping to landfilling, recycling and composting leads to following job creation:

Table 5.5 Number of jobs generated in 2020 thanks to improved waste treatment

	Landfill	Recycling	Composting
	Number of supplementary jobs generated in 2020		
Morocco	291	159	169
Algeria	663	430	207
Tunisia	180	256	109
Egypt	2843	877	108
Israel	-173	95 (+110 incineration)	85
OPT	141	71	31
Jordan	182	82	89
Lebanon	53	20*	18
Syria	572	233	138

** Waste to Energy is considered in Lebanon for major cities but is not included in the figures*

This is likely to be an underestimation, as waste collection and coverage in certain areas can lead to higher job creation, depending on the type of activities required and equipment available. A study undertook in Egypt showed for instance that up to 7 jobs could be created for every ton of waste managed (CWG/GIZ, 2011).

Box 5.3 Benefits of increased recycling in Algeria

Increased recycling leads to economic benefits, a part of which is in line with the monetary value of the recyclable material. The benefits calculated below correspond to the benefit of increased separate collection of recyclable material, material that can be sold for recycling under the below mentioned market values. In Algeria following indicative average values are observed, we use 2011 values :

Plastics for recycling	20 DA/kg	202,8 €/T
Metals for recycling	400 DA/kg	4.056 €/T
Paper for recycling	50 DA/kg	507 €/T

When 1 per cent is already recycled today, and we aim at 50 per cent recycling in 2030, we need to reach a level of 27.7 per cent recycling in 2020.

	Generation in020 (tonnes)	Recycling in 2020 (tonnes)
plastics	2.795.512	775,119
metal	735.203	03,852
paper	3.246.755	900,237

Benefits from increased recycling through the values of recyclable material can be assessed as follows, in actual prices:

plastic recycling	€157,194,173
metal recycling	€826,822,386
paper recycling	€456,419,996
total	€1,440,436,555

See Algeria Country Report for further information.

5.6 Methane emissions from waste

5.6.1 Introduction

When biodegradable waste is landfilled or dumped, anaerobic conditions may be generated in which it starts to decompose by bacterial activity, generating among other methane and CO_2 emissions. These greenhouse gasses contribute to the global warming. Socio-economic benefits are to be found in reduced global warming, reduced environmental and nuisance impact and use of the landfill gas as an energy resource.

5.6.2 Benefits of improving methane capture – quantitative and monetary assessment

We compare a baseline scenario, in which no changes occur in the way waste is collected and treated, with a target scenario, in which by 2030 the above mentioned recycling and landfill diversion targets would be met. See paragraph 5.5. The landfill gas emissions in the baseline scenario and in the target compliant scenario in 2020 are derived from an assessment of the total amount of waste landfilled, dumped and not collected. In the target scenario we supplementary assume that 20 per cent of all methane generated on landfills can be captured by landfill gas collection systems. The difference between both shows the amount of landfill gas emissions that supplementary can be avoided. The socio-economic benefits can be expressed in the marked values of avoided CO_2eq. In the table below the upper value of €56 per tonne in 2020 is used.

Table 5.6 Quantitative and monetary benefits from methane capture

	Quantitative	Monetary
	Methane emissions avoided in million m³	Value for avoided CO_2 eq. emissions in million €
Morocco	479	456
Algeria	894	851
Tunisia	485	462
Egypt	2,343	2,230
Israel	544	518
OPT	146	139
Jordan	202	192
Lebanon	82	78
Syria	379	360
Total	5554	5286

The major challenge consists of landfill diversion and recycling or composting of biodegradable waste, together with the switch to sanitary landfills and the equipment of the latter with methane capture installations. Next to the value of avoided CO_2 an interesting energy source can be found in the captured methane, either as a replacement for natural gas, or as a source to generate energy.

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Key messages – Nature

Biodiversity is of immense intrinsic value and human well being depends upon it. It is the 'natural capital' that provides a country, its economy and its people with a flow of goods and services that are fundamentally important for prosperity, livelihoods and well-being. The values we receive from our natural capital are immense, and failure to adequately take these values into account in our decisions exposes us to the risk of losing yet more of it.

Biodiversity in the region

- The status of biodiversity is poorly known in much of the region, but it is clear that there is on-going degradation of most ecosystems, and many associated species are declining. Consequently a substantial number of species are threatened nationally, some of which are at risk of global extinction.
- The main threats to biodiversity in the region include: overgrazing, cutting of forest and shrublands for firewood (leading to desertification), fires, expansion of agricultural land and agricultural intensification, poorly regulated quarrying, wetland drainage, pollution, illegal hunting and overexploitation of some species, especially fish, and the spread of invasive species.
- One of the principal means of protecting biodiversity (and associated natural capital) is through the protection of areas of very high biodiversity that are at risk of degradation. This is recognised by the CBD, which has set a target of achieving at least 17% protected area coverage of terrestrial and inland water bodies, and 10% of marine areas, by 2020. Although it is difficult to obtain consistent and up-to-date data on protected area coverage (due to differing national interpretations of protected area definitions, and on-going protected area expansion, it is clear that the achievement of the CBD target would substantially increase the protection of biodiversity within most countries in the region.
- Only Israel and Algeria currently have protected areas that exceed the CBD coverage target, whilst Egypt is close to the target and aims to reach it by 2017. The achievement of the CBD target would result in significant increases in protected area coverage, and associated biodiversity and ecosystem service benefits, in Jordan, Lebanon, Morocco, the occupied Palestinian territory, Syria and Tunisia.
- The status of marine protected areas in the region could not be reliably deduced from this study, but it appears that further protection of marine habitats is also required in most countries.
- It must be remembered that protected area coverage is a crude measure of biodiversity conservation effectiveness, as the strength of protection and appropriateness of land management measures within protected areas is of key importance. In this respect it is clear that considerable improvements could be made in the effectiveness of protected area management in the region.
- There is considerable uncertainty over the potential ecosystem service related benefits of increasing protected are coverage in the region. However, the

Key messages – Nature

assessments indicate that the most important benefits of increasing protected area coverage in the region are likely to be related to the protection of carbon reserves (especially in the peatlands of Belarus), the improvement of raw water resources in terms of quality and quantity (through better protection and management of vegetation in vulnerable catchments), capturing of pollutants from waste water and run-off (e.g. from agricultural land) in catchments of water bodies that are polluted or vulnerable to further pollution and habitat provision for threatened species. Some significant benefits could arise with regard to cultural services, but it is uncertain to what extent protected areas are needed to maintain such services in the region.

Forests, deforestation and carbon storage

Forest cover in the ENPI South region as a whole is at around 2 per cent of the territory (FAO 2011); the highest level is 13 per cent in Lebanon, 11.5 per cent in Morocco, 7 per cent in Israel and 6.5 per cent in Tunisia. Syria has just over 2.5 per cent forest cover. All others have less than 1 per cent forest coverage[24]. Egypt has the lowest percentage coverage at less that 0.1 per cent of territory being covered by forest.

- **Deforestation** is not currently an issue - at a net national level - in the region, with the exception of Algeria according to FAO data (however national data suggest net deforestation is less of an issue). In most countries there has been an increase in the overall forest area over the 20 year period - for example in Israel, Egypt and Tunisia. There are, however, concerns of **deforestation at local levels** and associated issues of **degradation** across the region. Furthermore, a loss of a hectare of old growth forests generally implies a far greater loss of ecosystem services (carbon stored, water retention and storage) and biodiversity than afforestation of new growth achieves – so the actual benefits of avoiding deforestation are more widespread and significant than average net national data would suggest. New growth or regeneration not only does not fully offset losses of old forest, but also in some countries current management practices do not allow natural regeneration, leading to increasing degradation and fragmentation. For instance, the reforestation rate in Morocco is considered well below the optimal rate (15 to 20 per cent for maintaining a functioning level of ecosystem services).
- While the current ENPI has focused on ENPI wide comparable data, building on FAO, future research is clearly needed on national and local data at both gross and net changes.
- Forests have **multiple uses**; in ENPI South a range have been designated specifically for production (particularly in Algeria, Tunisia and Morocco), for the protection of soil and water (particularly Libya and Jordan, but also Algeria, Egypt and Tunisia and to a less though still significant extent in Lebanon and Israel. A range of forests are also designated for the conservation of biodiversity – up to 18 per cent of forests in Israel and 12 per cent in Algeria and Morocco
- **Carbon storage**: ENPI South' forests contain 328 million metric tons of carbon in living forest biomass, equivalent to 1202 million tCO2. This is, however, an underestimate of

[24] OPT value has been estimated at 1.5% but the data appear less robust.

Key messages – Nature

the carbon storage in forests given that there are also important quantities in the soil and litter. Note also that the underlying data on carbon content per hectare of forest is still under-researched, and there are high variations across countries - e.g. highest in Egypt (near 100 tonnes C/ha for living biomass) and lowest in Tunisia (around 10 tonnes C/ha for living biomass). This can affect the total values. Similarly the existing data on forest carbon only covers the living biomass and does not include the carbon in the soil and litter. This can be very significant and the carbon store and the subsequent value calculations should be seen as an underestimate.

- Meeting the ENPI wide target of **halting deforestation** by 2020 will (at a net level and based on historical projections) only be a relevant target for Algeria (halting all deforestation would affect all countries as there is land use change in all countries). Were historical trends as noted in FAO to continue to 2020, there would be a potential to save above 180,000 hectares of forest in the next decade, corresponding to a net saving of about 11 million tons of CO_2 in living forest biomass.
- **Value of carbon storage**, avoided loss and stock gains: Assuming a value of CO_2 of €17.2 /ton (low) and €32 /ton (high) in 2010, the value of the carbon currently stored by the ENPI South forests ranges between €21 to €39 billion (see later point on stock and marginal values). Around two thirds of this large relates to Morocco's forests, the 5.1 million hectares, store 221 million tonnes C, equivalent to 809 mtCO2 and with a value range of €14 to €26 billion stock value today. Algeria has the second highest share at around 21 per cent. This is an indication of the value of the carbon stored in the living biomass today.
- By 2020, the **stock of carbon in living biomass** - assuming projected carbon values of €39/ton (low) and €56/ton (high) – would suggest values of €48 billion to €68.5 billion (stock value). In Algeria, halting forest loss by 2020, would (building on FAO data and projections to 2020) enable between €400 and 600 million of potential carbon losses to be avoided. Other countries can similarly avoid carbon losses and hence avoid emitting CO_2 in halting local deforestation or degradation where realistically possible.
- In other ENPI countries, the 'halting deforestation target' does not apply when looking at the national totals, hence to underline the benefits of forests as carbon store an estimate has been made of the projection in carbon value from the continued growth of forests – this has been estimated to lead to a carbon gain of €670 to 970 million for the ENPI South region from the growth in forests. The standing biomass also gains in value over the period given the expected rise in the 'value' of C02.

Land degradation - croplands

- The economic contribution of agriculture varies across the southern ENP countries, ranging from less than 3 per cent of GDP in Israel and Jordan to 20 per cent in Syria in 2008. The sector continues, however, to be a major source of employment, ranging from 20 to over 40 per cent in Algeria, Syria, Egypt and Morocco.
- Systematic and nationwide information on land degradation is scarce, but the global GLASOD survey indicates that severely and very severely degraded land ranges less than 10 per cent of the national land territory in Israel and Egypt to 60-80 per cent in Syria and Tunisia.

Key messages – Nature
• Improving agricultural crop land management and reversing land degradation have many benefits, including increased agricultural crop yields, reduced soil and agro-chemical run-offs, reduced sedimentation of rivers, lakes and reservoirs, reduced water pollution, and can contribute to reduced desertification. • Improved crop land quality from better land management may provide important benefits in term of increased crop yields, ranging from an estimated nationwide average of 2-3 per cent in Israel to 7-15 per cent in Jordan, Syria and Tunisia. • The benefits of these yield increases amount to €4.9-8.6 billion per year in 2020. This on average is equivalent to 0.36-0.65 per cent in the southern ENP countries, but as high as 0.6-1.0 per cent of GDP in Egypt, Morocco and Tunisia and 1.1-1.5 per cent of GDP in Syria in 2020.

6.1 Overview

All countries have an interest in understanding the importance of their country's natural assets – its land and forests, its coast and marine areas, its inland waters and wetlands, its biodiversity – the species, the ecosystems in which they live and their genes. This is the 'natural capital' that provides a country, its economy and its people with a flow of goods and services that are fundamentally important for prosperity, livelihoods and well-being. The values we receive from our natural capital are immense, and failure to adequately take these values into account in our decisions exposes us to the risk of losing yet more of it (TEEB 2011).

This chapter looks at the importance of nature in the ENPI countries. It starts (section 6.1) by articulating the ecosystem service issue so as to create a basis and context for the specific areas of analysis of this chapter, namely:

- Biodiversity itself – important for its intrinsic value, its uniqueness and for the benefits that we derive. The extent of the biodiversity is presented in section 6.2.
- Forest cover and deforestation – forest are critical carbon stores for the planet (and much more). Appreciating the capital stock and the need to halt or avoid deforestation (and degradation) is critical. Section 6.3 presents the parameter of 'halting deforestation'.
- Section 6.4 looks at cropland degradation – this is important for productivity and wellbeing as well as for a range of ecosystem services.

While a chapter cannot do justice to the wide issue that is nature, it is hoped that highlighting some specific aspects will help demonstrate not only valuable evidence on value, but that would be in the interests of nations to explore further the value of nature and of course move to implementing the 20 targets under the CBD Strategic Plan 2011-2020.

Insights on nature, natural capital and ecosystem services[25]

Ecosystem Services, as noted in chapter 1, refer to the flow of benefits that people obtain from ecosystems (MA 2005a). These include:

- *provisioning services* (e.g. food, fibre, fuel, water);
- *regulating services* (benefits from ecosystem processes that regulate e.g. climate, floods, disease, waste and water quality);
- *cultural services* (e.g. recreation, tourism and aesthetic, spiritual and ethical values);
- *supporting services* necessary for the production of all other ecosystem services (e.g. soil formation, photosynthesis, nutrient cycling).

Habitat services' is also a separate classification to highlight the importance of ecosystems to provide habitats for migratory species (e.g. as nurseries) and as gene-pool 'protectors' (maintain genet pool diversity and vitality) (see TEEB Ecological and Economic Foundations, 2010). See Boxes 6.1 and 6.2 for definitions, descriptions, borrowing from TEEB (2010).

As noted in TEEB 2011, Ecosystem services flow from the 'natural capital stocks', like interest or dividends from the stock (also sometimes termed 'natural assets'). 'Natural capital' is an 'economic metaphor for the limited stocks of physical and biological resources found on earth' (MA 2005a). See section 1.3 and Chapter 3 for additional definitions and insights on 'natural capital' and TEEB Ecological and Economic Foundations (2010).

The relationship between biodiversity and ecosystems (see box below) and their ability to deliver vital services is complex and variable. Ecosystems are components of biodiversity and species are essential components within those ecosystems. The loss of components of biodiversity may trigger a significant and detrimental change in services provided by the ecosystem concerned.

Depending on the circumstances, such changes can (initially) be subtle or make ecosystems less stable and more vulnerable to collapse. The loss can be linear in some case, exponential in others (fragile ecosystems near tipping points) or initially very low (if the loss of one component of the ecosystem is substitutable by another) though with a risk of sharp loss later[26].

If an entire ecosystem is lost, this will have a significant structural impact with direct human, social and economic costs.

25 This section builds on TEEB (2011)

26 It depends on the ecosystems functional diversity and related redundancy levels. Thus some components can be lost with no perceptible impacts on ecosystem services. The main issue is that we often do not know what can be lost without detrimental impacts and we do not know how close we are to key thresholds.

Box 6.1 Definitions: biological diversity and ecosystems

Biological diversity means *'the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'* (Article 2, Convention on Biological Diversity (CBD) (UN 1993). The term covers every form of life on earth (plants, animals, fungi and micro-organisms), the diversity of communities that they form and the habitats in which they live. It encompasses three levels: ecosystem diversity (i.e. variety of ecosystems); species diversity (i.e. variety of different species); and genetic diversity (i.e. variety of genes within species).

Ecosystem means '*a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit*' (Article 2, CBD) (UN 1993). Every ecosystem is characterized by complex relationships between living (biotic) and non-living (abiotic) components (resources), sunlight, air, water, minerals and nutrients: the quantity (e.g. biomass, productivity), quality and diversity of species (e.g. richness, rarity) all play an important role. The functioning of an ecosystem often hinges on certain species or groups of species that perform key functions e.g. pollination, grazing, predation, nitrogen fixing.

Box 6.2 Ecosystem services – overview and definitions

Provisioning Services are ecosystem services that describe the material outputs from ecosystems. They include food, water and other resources.

Food: Ecosystems provide the conditions for growing food – in wild habitats and in managed agro-ecosystems.

Raw materials: Ecosystems provide a great diversity of materials for construction and fuel.

Fresh water: Ecosystems provide surface and groundwater.

Medicinal resources: Many plants are used as traditional medicines and as input for the pharmaceutical industry.

Regulating Services are the services that ecosystems provide by acting as regulators eg regulating the quality of air and soil or by providing flood and disease control.

Local climate and air quality regulation: Trees provide shade and remove pollutants from the atmosphere. Forests influence rainfall.

Carbon sequestration and storage: As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues.

Moderation of extreme events: Ecosystems and living organisms create buffers against natural hazards such as floods, storms, and landslides.

Waste-water treatment: Micro-organisms in soil and in wetlands decompose human and animal waste, as well as many pollutants.

Erosion prevention and maintenance of soil fertility: Soil erosion is a key factor in the process of land degradation and desertification.

Pollination: Some 87 out of the 115 leading global food crops depend upon animal pollination including important cash crops such as cocoa and coffee.

Biological control: Ecosystems are important for regulating pests and vector borne diseases.

Habitat or Supporting Services underpin almost all other services. Ecosystems provide living spaces for plants or animals; they also maintain a diversity of different breeds of plants and animals.

Habitats for species: Habitats provide everything that an individual plant or animal needs to survive. Migratory species need habitats along their migrating routes.

Maintenance of genetic diversity: Genetic diversity distinguishes different breeds or races, providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock.

Cultural Services include the non-material benefits people obtain from contact with ecosystems. They include aesthetic, spiritual and psychological benefits.

Recreation and mental and physical health: The role of natural landscapes and urban green space for maintaining mental and physical health is increasingly being recognized.

Tourism: Nature tourism provides considerable economic benefits and is a vital source of income for many countries.

Aesthetic appreciation and inspiration for culture, art and design: Language, knowledge and appreciation of the natural environment have been intimately related throughout human history.

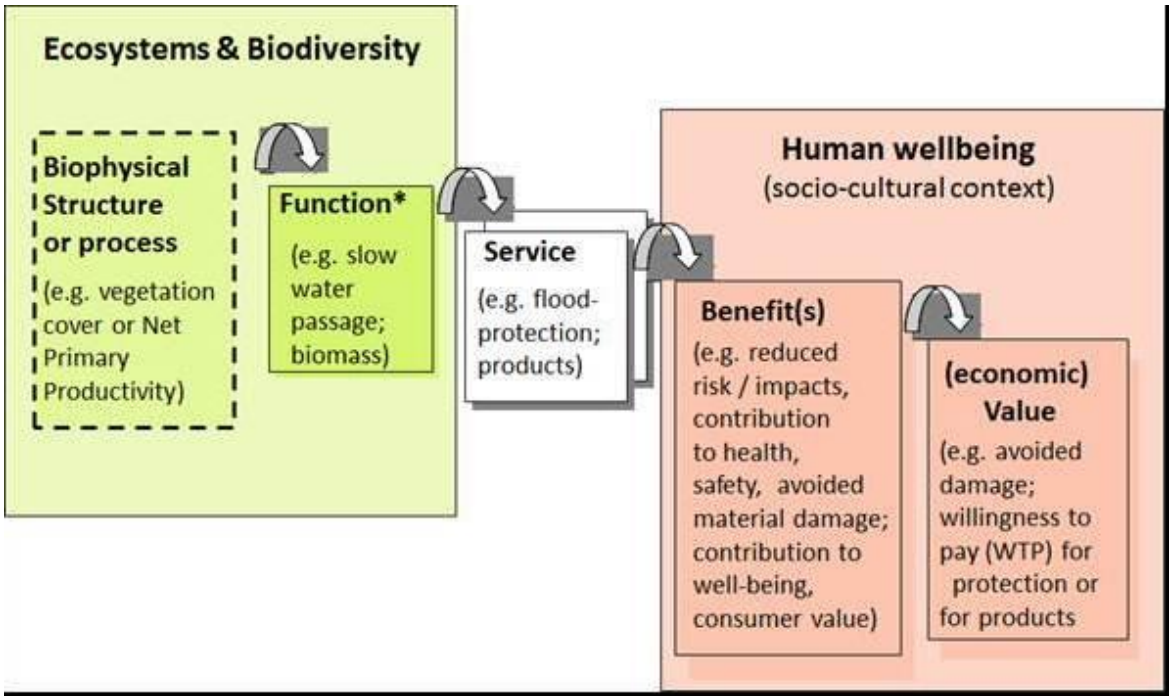
Spiritual experience and sense of place: Nature is a common element of all major religions; natural landscapes also form local identity and sense of belonging.

Icons designed by Jan Sasse for TEEB. They are available for download at www.teebweb.org

Many factors influence ecosystem resilience and the likely extent and rate of changes to ecosystem services. Examples include species abundance, level of biomass, quality and structure of natural habitats and level of genetic diversity. Some services are directly linked to species' detailed composition and diversity (e.g. pollination, many cultural services).

Others, like flood regulation, depend on the role of physical structures and processes at the ecosystem scale (for more detailed scientific discussion, see TEEB Foundations 2010) (see Figure below).

Figure 6.1 The pathway from ecosystem structure and processes to human well-being



Source: Adapted from Haines-Young and Potschin (2009) and Maltby (2009)

Many economic sectors depend on biodiversity and ecosystem services to a varying extent, including agriculture, fisheries, forestry, development, health, energy, transport and industry. Several need 'natural capital' for their flow of inputs, research, new products and business innovation (TEEB 2011). Countries are thus highly dependent on their natural resources and biodiversity, which can significantly contribute to poverty alleviation. For example, nearly all of the protected areas in Morocco host communities living on agriculture and forestry. The challenge for governments consists of reconciling biodiversity conservation, a sustainable use of the natural resources and the legitimate interests of traditional users. Overall, the effectiveness of protected areas management and the protection of the national biological richness of each country should be significantly strengthened.

As noted above, this chapter focuses on a subset of issues – first biodiversity, looking at the level of biodiversity protection; then looking at deforestation and forest carbon issues, and finally looking at rangeland degradation. Other issues to do with natural capital – for example the provisioning of clean water are explored in the water chapter. The issue of natural capital and the value of nature is a fast moving field since the Millennium Ecosystem Assessment came out in 2005 (MA, 2005) and accelerated by the TEEB process (TEEB 2008, 2009, 2010 and 2011) and recognised in the CBD Strategic Plan agreed and launched at the COP 10 in Nagoya (CBD 2010).

6.2 Biodiversity protection

6.2.1 Introduction

One of the most effective means of conserving biodiversity is through the establishment and appropriate management of protected areas. An area is considered by IUCN to be protected for nature conservation purposes if it is 'a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values' (Dudley, 2008). These can be managed by governments, privately, have shared governance and also potentially involve community management. The benefit assessment of this sub-theme therefore uses the proportion of land designated as protected areas in each country as an indicator of the country's efforts to maintain biodiversity.

The proportion of land designated as protected areas (in accordance with IUCN definitions) is a widely used indicator of efforts to conserve biodiversity, and is for example included in the CBD set of biodiversity indicators[27] and the SEBI (Streamlining European Biodiversity indicators) set used in the EU[28]. This is because protected areas are a key instrument used to conserve biodiversity and reasonably comprehensive and standardised data exist for most countries on national protected area designations, which have been compiled in a central World Database of Protected Areas (WDPA)[29]. However, as further discussed below, it should be remembered that the formal protection of a site does not necessarily mean that the level of protection and management of the site is sufficient to adequately conserve biodiversity within it. There are also other means of conserving biodiversity that do not need protected area designation, and conservation measures in the wider environment (i.e. outside biodiversity-rich areas) is also important.

6.2.2 Current status in the region

Overview of key ecosystems

The countries covered in this southern ENPI regional report encompass a wide variety of ecosystems and habitats. However, the majority of the region consists of arid habitats, especially away from the coast and the larger river valleys. Semi-desert areas and desert wadis support sparse grasslands and shrublands, which are mostly used for goat and sheep grazing. Large areas of the region consist of true sand and rock desert (particularly in the south of the region), which are mostly devoid of vegetation, but are nevertheless of high biodiversity value for their specialist species and communities.

Mediterranean coastal areas receive more rainfall, and as a result these regions support woodland and shrubland ecosystems. These used to dominate large areas (such as in northern Israel), but a high proportion has ben converted into agricultural land, urban areas,

27 CBD biodiversity indicators

28 http://biodiversity-chm.eea.europa.eu/information/fol168004

29 http://www.wdpa.org/

or planted forests (mostly pine). Similarly the humid river valleys (such as that of the Nile) used to support extensive wetlands and floodplain grasslands, but most of these natural habitats have now been converted to agriculture.

The region does have some mountain ranges, including the Atlas mountains in Morocco and Algeria, as well as high mountains in Lebanon and Syria. These support most of the natural forest areas within the region, and are of high biodiversity value.

Marine habitats within the region are also of high biodiversity importance, in particular the coral reefs of the Red Sea.

Status of biodiversity and threats

Large parts of the region are remote areas of desert that are little developed, and therefore threats to biodiversity in such areas are relatively few. Nevertheless, substantial areas of grasslands and shrublands are affected by the overgrazing by livestock (see an example for Morocco in the box below), leading to vegetation degradation, soil erosion and desertification. In the past traditional pastoralism was relatively limited, but current use of vehicles to transport herds to grazing areas has led to rapid depletion of grazing grounds in large areas, and the grazing of marginal habitats in distant localities. This led to the maintenance of larger herds that exceed the carrying capacity of their environment. This problem is further exacerbated by the widespread cutting of remaining areas of woodland and shrubland for firewood.

Elsewhere and particularly in more populated areas, such as along the coasts and river valleys, biodiversity is under significant and increasing pressures, primarily as a result of:

- population growth, rapid urbanisation (combined with poor planning),
- Fires
- Wetland drainage.
- Unsustainable agricultural practices, agriculture expansion (e.g. through conversion of grasslands to arable farming) and intensification (e.g. irrigation, intensive use of pesticides and fertilizers, overgrazing).
- Contamination of the environment (land and water resources) with industrial and urban wastes.
- Poorly regulated quarrying (e.g. in Lebanon)
- Infrastructure development resulting in habitat loss, fragmentation and disturbance.
- Illegal hunting and overexploitation of some species, especially fish.
- Invasive species, particularly fish and some exotic plants
- unsustainable tourism

Marine habitats are increasingly affected by an expansion of fish farming, whilst coral reefs are subject to damage from tourism and ships. However, undoubtedly the most severe threat to coral reefs is bleaching due to climate change.

Box 6.3 The cedar of the Atlas: threats and benefits

In Morocco cedar trees cover approximately 130,000 ha in the area situated in the Rif and the Middle-Atlas. Cedar forests shelter a rich fauna of numerous birds as well as mammals like the Red Fox, the Mongoose and especially the emblematic Monkey (the magot).

However, cedars are threatened by chronic overgrazing which destroys the undergrowth, illegal cuttings and parasites that precipitate the mortality of veterans weakened by drought.

The non-renewal of cedar does not only mean the end of an ecosystem, but also the disappearance of a long craft tradition. The wood of the cedar is the wood par excellence for craftsmen in Morocco. It is traditionally used for furniture, ceilings, doors in Fes and Chefchaouen.

Protection area coverage

The extent of terrestrial protected areas in each country in the region is presented below, (see Table 6.1), together with an estimate of the percentage land area currently covered, and national targets for coverage (if they exist or are known). The assessment has revealed that it is difficult to obtain consistent and up-to-date data on protected area coverage, this is primarily due to differing national interpretations of protected area definitions, which has been further complicated by changes to the IUCN definitions of protected areas and their categories in 2008. Furthermore, many countries are currently expanding their protected area networks and reviewing their structure and governance. As a result central databases such as the WDPA do not always have up-to-date data. Due to these problems it has not been possible to break-down the protected area data by IUCN category, as has been carried out for most countries in the ENPI-South region. Data on marine protected areas is especially incomplete and inconsistent, and therefore it has also not been possible to compile an overall assessment of progress towards the CBD target for marine protected areas.

Despite the data limitations, it is clear that several countries in the region have designated significant proportions of their countries as protected areas, in particular in Algeria (although the vast majority of the area is two very large desert areas), Israel and Egypt. Furthermore in Israel another 259 nature reserves (2,690 km2) and 75 national parks (100 km2) are currently in the planning process, and when added the protected area network will cover almost a third of Israel's territory. Most other countries have very limited protected areas, although several are currently expanding them.

Table 6.1 The area and percentage of each country that falls within terrestrial protected areas, and national targets for protected area coverage

Country	Total PA area (km2)	PA % of land (including water bodies)	National PA target %	Refs/ Notes
Algeria	**532,338**	22.3%	Unknown.	
Egypt	**~150,000**	15%	20% by 2017	1
Jordan	**1,336**	1.5%	4.8%	2
Lebanon	**313.6**	<3%	Unknown	3
Israel	**4,076**	18.8%	35% by 2020	4
Morocco	**7720**	1.0%	3%	5
OPT	**>579**	>3.8%	None	6
Syria	**12,046**	6.5%	10%	7
Tunisia	**2,179**	2.5%		8

Reference sources / notes:
1. Total area based on Ibrahim (2011) and adjusted for terrestrial area, national target based on EEAA, 2009. 2.The last CBD report (MOE 2009-CBD 4th Report) suggests that protected areas may cover 3.8% of the territory, but it is not clear if they are all protected areas as defined by IUCN. 3. Tentative figures provided by the MOE of Lebanon as three nature reserves and protected areas were added to the PAs in 2010 with originally 2.12% PA of land until 2009. 4. Israel does not have a PA target, but if its protected area intentions are implanted then 35% of the country will be covered by 2020. 5. Data based on correspondence from the Chef de la Division des Parcs et Réserves Naturelles, Direction de la Lutte Contre la Désertification et la Protection de la Nature, Haut Commissariat aux Eaux et Forêts et à la Lutte Contre la Désertification. The protected area network is being expanded, but current progress is uncertain. 6. The quoted area refers to nature reserves that have been designated by the Israeli civil administration, few of which are under Palestinian Authority control. There are no Israeli-designated nature reserves in the Gaza strip, but the Palestinian Authority established the Wadi Gaza nature reserve in June 2000. 7. Protected area size data refer to 2009 and are provided by MOSEA; includes 147.5 km of wetlands; target year uncertain. 8. Area excludes Ramsar sites, but included in % coverage. Tunisia is creating new national parks and natural reserves, but no precise data on the target % of PA coverage are available.

Box 6.4 Protected area management categories defined by IUCN

CATEGORY Ia: Strict Nature Reserve: protected area managed mainly for science

CATEGORY Ib Wilderness Area: protected area managed mainly for wilderness protection

CATEGORY II National Park: protected area managed mainly for ecosystem protection and recreation

CATEGORY III Natural Monument: protected area managed mainly for conservation of specific natural features

CATEGORY IV Habitat/Species Management Area: protected area managed mainly for conservation through management intervention

CATEGORY V Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation

CATEGORY VI Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

Source: Dudley, 2008

Up to date data on the current status of marine protected areas in the region is incomplete, but marine protected areas include:

- Jordan - the Aqaba Marine Park, which lies in Jordan's territorial water in the Gulf of Aqaba,
- Israel - coastal and marine areas comprise 14 nature reserves (9.7 km^2) and 23 national parks (18.3 km^2), which were designated in 2002, equivalent to about 6.5% of Israel's marine waters,
- Egypt - there are 8 marine protected areas designated, covering 5,396 km^2, which is 9.91% of marine waters.

6.2.3 Potential environmental improvements

In order to assess the benefits related to protected areas an ENP study-wide protected area coverage target was used, based on the CBD Strategic Plan for 2011-2020 (see Box 6.5), are at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas (if applicable), are conserved through effective management practices. This was used as the target for the ENPI study.

It should be noted, however, that the CBD target may not be adequate according to national circumstances (including the importance of biodiversity in the country and the need for protected areas to reduce threats to it). National targets are therefore also considered, as they may be account the biodiversity importance of the country and the need for protected area designations. The CBD target is therefore more of a tool to allow comparability across the country studies, rather than an appropriate target for each country.

Box 6.5 CBD Strategic Plan 2011-2020

Strategic goal C: *To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity*

Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.

This is a global target and no specific national 'target effort sharing' has been elaborated.

Source: http://www.cbd.int/sp/targets

The level of protected area coverage in the region is dynamic, with a range of countries having set targets and progressing towards these, including Egypt, Israel, Jordan and Syria. Nevertheless, despite the current increase in protected area coverage it is clear that the achievement of the CBD target for terrestrial protected areas would substantially increase the protection of biodiversity within the region. Only Israel and Algeria currently have protected areas that exceed the CBD coverage target (and further protection of habitats other than in the Saharan desert may be appropriate in Algeria), whilst Egypt is close to the target and aims to reach it by 2017. The achievement of the CBD target would result in significant increases in protected area coverage, and associated biodiversity and ecosystem

service benefits, in Jordan, Lebanon, Morocco, the occupied Palestinian territory, Syria and Tunisia.

The status of marine protected areas in the region could not be reliably deduced from this study, but it appears that further protection of marine habitats is also required in most countries.

It is important to note that the percentage of a country designated as protected areas does not provide a reliable indication of the adequacy of the proportion protected (as this will vary according to the ecological / biodiversity value of the country), the ecological coherence of the protected areas as a network, the level or effectiveness of protection given to biodiversity within protected areas, or the degree to which positive management measures are undertaken within them. Also many countries have important biodiversity resources outside their protected area networks, which may be conserved to varying degrees through various instruments in the wider environment.

It was beyond the scope of this study to assess the effectiveness of protected area management in each country, and, as with protected area coverage, up-to-date data are difficult to obtain. Nevertheless, some of the country reports noted that the management of protected areas could be improved. For example, in Lebanon, only 6 out of 10 PAs have management plans, and the funding provided for management activities is often irregular, jeopardising their sustainability. In Morocco the management effectiveness of protected areas could be significantly improved and the protection of the national biological richness of the country could be strengthened. This is in part due to The Forestry Service (Haut Commissariat aux Eaux Forêts et à la Lutte contre la Désertification or HCEFLCD) having inadequate resources to develop and implement management plans for all the protected areas. Management of the sites in relation to their use by people is also a major challenge, as nearly all, of the protected areas in Morocco have people living in them and using them, e.g. for grazing livestock, crop production and collection of firewood (USAID, 2008).

In general, key constraints to conservation of terrestrial biodiversity across the ENPI South region include:

- Land tenure rights: the land tenure system provides very little incentive for local people to conserve the forest. Commercial products from organized timber sales are almost always harvested by relatively wealthy urban elite. Receipts from timber sales and other biodiversity products go to local government (the communes). Those who live in or near the forest are systematically excluded from the direct financial benefits from forest products. Receiving no legal monetary benefits from the forest, individuals exploit the forest illegally whenever they think they can get away with it.
- Resource access rights: nearly all forest lands are used as grazing lands. Nearly all forest lands, and much of the steppes, are state-owned. All of the livestock that use these lands are privately owned. Most of the livestock are owned by absentee owners. Access to most grazing lands is *de facto* open access, negating any possibility of management. Forest and/or range management can only be effective if local populations and livestock owners are involved, but participatory management approaches are very poorly developed.

- Other constraints include a sectoral approach focusing on management for wood products, legal/policy constraints, insufficient institutional capacities, low political commitment and the lack of a Red List of endangered species.

Constraints to marine conservation include:

- Inadequate involvement of coastal fishermen in the management of the coastal fisheries resource. There has been very little development of participatory management of marine and aquatic resources.
- Most coastal fisheries and freshwater aquatic ecosystems are quasi open access resources. This is especially true for the tidal zone fisheries. The state tries to regulate use, but lacks the means.
- Law enforcement tends to favour the economically powerful bodies and artisanal fishermen are poorly organized, poorly informed and poorly represented in key fora.
- Industrial fishing boats commonly enter into coastal waters legally reserved for artisanal fishermen.
- A major shortage of scientific expertise and information for marine ecosystems, ecology, biology, restoration.

6.2.4 Benefits of improving biodiversity protection – qualitative assessment

Numerous studies, such as the MEA and TEEB assessment have shown the value of biodiversity in terms providing ecosystem services (see section 6.1 above) and a summary of those that are likely to benefit from increasing protected area coverage is provided in Table 6.2 below (further details of potential benefits relating to the protection of forests is provided in the section 6.3). However, the benefits of such services have been infrequently and incompletely studied in the countries covered by this study. Furthermore, the benefits provided by each protected area will vary considerably depending on its context, such as its ecosystem type and condition, and the need for its potential ecosystem services (globally and locally). It has therefore not been possible to reliably quantify the benefits of increasing protected area coverage in each country or calculate their monetary value.

However, those services that are likely to benefit most from the protection of terrestrial and freshwater ecosystems in the region (from the information that was supplied in the country studies, and other studies such as the MEA) are highlighted in the table below.

The assessments indicate that the most important benefits of increasing protected area coverage in the region are likely to relate to the water resources (storage and water purification / waste assimilation) and tourism. Although ecotourism within terrestrial protected areas in many parts of the region is relatively limited, it has been shown to be economic significance in Israel (see Box 6.6 below). Furthermore, many tourists do visit Israel and Egypt region specifically to dive on the coral reefs in the Red Sea. For instance, according to the Egypt country report, visitors in diving areas ranged between 10,000 and 60,000 annually.

A research study in Israel assessed divers' willingness to pay (WTP) for marine biodiversity (i.e. a greater abundance and variety of species), as well as improved visibility, in the Eilat Coral Beach Nature Reserve in the Red Sea. The study by Wielgus et al. (2003) found that divers were willing to pay an additional NIS 11.86 (€2.85 in 2008 prices) per dive, on top of the existing diving fee of NIS 20, for each additional unit in a biological index that measures coral and fish abundance and richness of species. This compares to a WTP of NIS 5.46 (€1.30) per dive for each additional meter of visibility. The total value of an overall improvement of environmental quality, which would take the Eilat reef to a level found in the (higher-quality) Sinai reefs, was valued at NIS 13.2 million/year (€3.17 million in 2008 prices).

Insufficient information was received from the country studies to reliably assess the contribution that marine protected areas could make to the protection and enhancement of ecosystem services other than tourism. However, evidence from studies elsewhere, such as in the Mediterranean Plan (Plan Bleu, 2005) have shown that marine ecosystems can also provide very high economic benefits from fisheries, CO_2 sequestration, waste assimilation and protection of coastlines. Marine protected areas could undoubtedly help to protect and enhance such benefits through the protection of fisheries (e.g. creating sources for stock replenishment) and the safeguard of clean water, nature and landscapes which is fundamental to much coastal tourism. However, they are unlikely to be able to significantly mitigate the long-term impacts of climate change on coral reefs.

In Lebanon, the biodiversity resources and ecosystem services have not been valued yet, due to knowledge gaps about the direct and indirect biodiversity services and ecosystem functions (Sattout & Abboud, 2007 as cited in MOE/UNDP/GEF, 2009). The economic value of different forest ecosystems in Lebanon was estimated at about €89.9 million, where the economic value of medicinal and aromatic plants was estimated at €16.1 million and that of honey production at €9.2 million (Sattout et al., 2005 as cited in MOE/UNDP/GEF 2009). The economic value of legal game birds was estimated at € 9.2 million in terms of meat and €4.5 million in terms of licenses value (Ramadan-Jaradi 2008 as cited in MOE/UNDP/GEF, 2009).

Case studies of the potential benefits of increasing protected areas in Israel, and protecting coral reefs in Egypt is included below.

Key for typical relative importance: + = most likely to increase the service, - likely to result in a decrease in the service H = High, M = Moderate, L = Low, ? benefit is uncertain, V = benefits likely to vary from high to low according to local circumstances, U = unknown.

Table 6.2 Overview of key benefits of increasing terrestrial & freshwater protected area coverage

	Typical relative importance	Rationale for assessment and related observations
Provisioning services		
Food	-L	Agricultural production may be reduced in some areas, but benefits may arise from more sustainable production in some areas if appropriately managed
Raw materials	Nil	Timber and other raw materials unlikely to be significant in PAs in the region
Freshwater	+M/H	Likely to improve water quality if protected areas are appropriately protected and managed (e.g. reductions in overgrazing)
Medicinal resources	+L?	Many species in the region have probably been screened for medicinal benefits, but it is difficult to predict future needs and opportunities.

Table 6.2 Overview of key benefits of increasing terrestrial & freshwater protected area coverage		
Regulating services		
Local climate and air quality	+L	Most new protected areas are likely to be outside cities (where small areas of green space can provide such benefits) and others will not be of sufficient size to affect local climates
Carbon sequestration and storage	+L?	New protected areas are unlikely to hold carbon rich soils or forest vegetation
Moderation of extreme events	+M	Improved protection and managements of coastal mangroves, forests and grasslands, could provide increased protection from landslides, floods and storms
Waste-water treatment	+M/H	Many of the water bodies in the region and surrounding areas are highly polluted, especially from nutrients. Maintenance of forest and grassland cover in catchments, and downstream wetlands, could help filter out and capture significant pollutants
Erosion prevention and maintenance of soil fertility	+L	Some areas are overgrazed and therefore prone to erosion, especially in hilly and mountainous regions.
Pollination	U	Natural and semi-natural vegetation can provide important habitat for pollinators that can provide benefits for nearby crops. However, the status of pollinator populations in the region is uncertain and if populations are significantly depleted the potential gain may be limited because many protected areas are unlikely to be close to large areas of cropland where pollinator populations are depleted.
Biological control	+L?	Natural and semi-natural vegetation can provide important habitat for predators of pest species that can provide benefits for nearby crops. However, many protected areas are unlikely to be close to large areas of cropland where such impacts could be significant.
Habitat or supporting services		
Habitats for species	+H?	As noted above the relative levels of protected area provision are low in most countries, and therefore an increase to 17 per cent (CBD target) has the potential to significantly improve the conservation of many ecosystems and associated species in the region that are threatened or declining. However, the effectiveness of protected areas will be highly dependent on the level of protection and the implementation of pro-active management. There is currently little information available on the effectiveness of protected areas in the region, therefore there is some uncertainty over the level of potential benefit of simply increasing protected area coverage.
Maintenance of genetic diversity	+M?	Some scope for using traditional breeds of livestock to manage protected areas, as these are often most suitable for grazing semi-natural habitats. But needs and opportunities are uncertain.
Cultural services		
Recreation and mental and physical health	+L?	There are well documented benefits from outdoor recreation etc., but the maintenance of green space is not highly dependent on protected area designations, and most recreation benefits are not clearly linked to levels of biodiversity within them.
Tourism	+M?	Many protected areas, especially in scenic locations, are major tourist attractions. However, most tourism is related to landscape quality and not closely linked to biodiversity, other than with respect to coral reefs. It is uncertain to what extent landscape quality is widely threatened in the region or what the potential for tourism growth is in new protected areas, therefore the added value of increasing protected area coverage is uncertain. Although coral reefs are of major importance for ecotourism it is unclear to what extent they can protect them from the principal threat of climate change.
Aesthetic appreciation and inspiration	+L/M?	As noted above, many protected areas are of very high aesthetic value, however, the need for increased protection of areas in the region to maintain such values is uncertain.
Spiritual experience and sense of place	V	Such benefits will be highly context specific, with some protected areas being of very high value, whilst others (especially artificial habitats) may have no spiritual value

Box 6.6 Benefits of protection of a wetland in Israel

While a complete monetary assessment of the benefits of improving biodiversity protection is well beyond the scope of this work, some insights can be gained from local case studies (see also the case study on the Mount Carmel Forest further below).

One of the better-documented cases is the Hula project in the Upper Galilee. The Hula wetland had been drained in the 1950s to provide land for agriculture and create local employment. However, these expected benefits did not materialise: not only did the soil quality deteriorate, rendering agriculture unprofitable, but the draining also meant that the wetland could no longer provide the nutrient cycling service, resulting in nitrification of the downstream Sea of Galilee (Baron and Zaitsev 2000). Most importantly, though, the drained wetland was reduced to a small remnant, and ceased to function as a habitat for local biodiversity, leading to a notable drop in species observed in the region. In response, the Hula wetland was restored in 1994. It has since again become an important habitat, including for a variety of endemic and migratory bird species including cranes, storks, pelicans, cormorants, herons and almost 300 other species. Since the restoration, the Hula reserve has become a centre of bird watching in Israel, and attracts some 250,000 visits each year – predominantly Israeli, but increasingly also foreign visitors (Ministry of the Environment 2006).

In 1997, Baron et al. assessed the economic benefits of the Hula reserve by means of a contingent valuation study. Through this study, the authors assessed how much tourists visiting the area would be willing to pay in entrance fees for the Hula reserve. They estimated the mean willingness to pay at NIS 30 (€9.46 in 2008 prices). They also estimated an increase in the number of overnight stays in the region by about 35,000 – 40,000, a number which expected to grow over time and lead to additional revenue for hotels, guesthouses and campsites in the region. The average expenditure for accommodation was estimated at NIS 633 per family (€200 in 2008 prices). About a quarter of the surveyed visitors had also visited a restaurant in the region, spending an average of NIS 197 per family (€62 in 2008 prices).

As a crude approximation, the benefits of increasing the protected area in Israel can be estimated in the following way. As described above, achieving the target of designating 35 per cent of Israel's land area as protected area in 2020 can be associated with an increase in the number of visits to these areas by 1.3 – 3.8 million visits per year. Using Barons 1997 estimate of the willingness to pay of NIS 30 per visit – equivalent to NIS 47 or €9.46 at 2008 prices – the annual benefit of additional recreation opportunities could be valued at NIS 60.2 – 180.6 million (€12.1 – 36.4 million) at 2008 prices. As such, this number is likely to both under- and over-estimate the actual benefits: it is an overestimate, as the Hula reserve is recognised as an area of particular ecological value, boasting a rich variety of species. It is therefore possible that other areas would elicit a lower willingness to pay. At the same time, the monetary value is a gross underestimate of the economic value, as it only measures the amenity value of the site for visitors seeking recreation and relaxation, but does not include the multitude of other services that the protected areas may deliver.

Table 6.3 Benefits of extending protected areas, 2008 - 2020

Protected area 2008	Protected area 2020	Additional visits 2020		Monetary value 2020 (€)	
		Lower bound	Upper bound	Lower bound	Upper Bound
4,076 km^2	7,575 km^2	,282,857	3,8,570	12,135,824	36,407,472

Source: Authors' own estimates, valuation based on Baron et al. 1997

Box 6.7 The benefits of coral reefs in Egypt

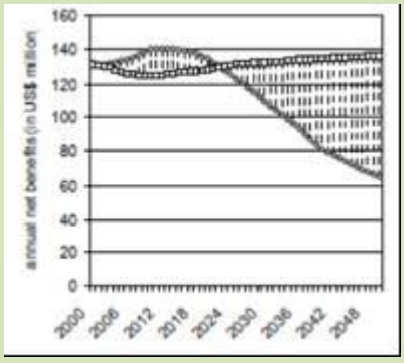
In Egypt coral reefs extend along most of the shoreline of the southern part of Sinai (EEAA, 2010b). There is no official estimate of the area covered by coral reefs, but it is estimated to be over 4,000 km2 (Cesar, 2003).

Coral reefs represent some of the most biologically diverse ecosystems in Egypt, providing critical habitat for many marine species. Furthermore, they provide a large number of other ecosystem services, such as shoreline protection, generation of coral sand, other biotic services - like the regulation of ecosystem processes and functions - and bio-geo-chemical services - like nitrogen fixation. They are also a critical resource for tourism. More than 2 million tourists visit the Egyptian Red Sea, and between 30 and 100 per cent of them are direct users of the reefs (Cesar, 2003). Income generated from coral reefs and mangroves have been estimated at about 80 million LE30 (EEA, 2009), i.e. €10 million per km2

Several threats, such as development in coastal areas, tourism, over-fishing, shipping and pollution (especially from untreated sewage) have contributed to a global loss of over 10 per cent of these valuable ecosystems. An additional 15 per cent have been lost due to warming of the surface ocean, and it is expected that climate change will further contribute to coral reef degradation in the decades ahead (EEAA, 2010b).

A study by Cesar (2003) estimated the monetary benefits related to tourism revenues, fishery, research, bioprospecting and biodiversity, by comparing a business as usual scenario with a sustainable management scenario in 2050.

Figure 6.2 Changes in annual benefits over time, Egypt



Should the level of exploitation and pressure to the coral reef remain the same, it is expected that the benefits will be higher in the short run, due to the increase in tourism activity. However, the net benefits will decrease in the long run, as the value added per tourist will decrease in response to the deterioration of the reef. In the year 2050 this will cause the value of the reef to fall to half of its current value. Sustainable management will instead allow the current benefits to remain constant, or slightly increase, in the long term – see figure.

Source: Cesar, 2003

The net benefit of sustainable management, using a net present value with no discounting, are estimated to be about €1 billion (US$930 million31). Using a 5 per cent discount rate, the net benefits would be about €217 million. This is likely to be an underestimate, as not all the benefits could be monetised (e.g. avoided rehabilitation costs). Furthermore, if a longer time horizon is used, to account for the benefits of three or more generations, the net benefits would be even larger.

30 Using an exchange rate for 2008 of 0.13 LE/€

31 Using an average exchange rate of 1.08 US$/€ for the year 2000.

6.3 Deforestation levels

6.3.1 Introduction

The benefit assessment on this subtheme on deforestation looks at the benefits of avoided deforestation (where applicable), which have to be seen in the context of the current forest cover and benefits, and the trend in loss/gain of forest coverage. While forest loss and the loss of carbon storage and wider range of ecosystem services is an issue for all countries (at least at a local level). At a net national level deforestation is an issue in only a subset of ENPI countries. In ENPI South it concerns mainly Algeria.

For a range of countries there has been a significant growth of forest coverage that is has led to a growth in carbon storage and hence a contribution to climate change mitigation. These countries include Egypt, Morocco and Tunisia in ENPI South. Given the importance of climate change and the site specific nature of many of the above services, this study has focused primarily on carbon storage value of forests to help illustrate a value of forests and the importance of addressing deforestation (see further below on wider ecosystem services).

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This parameter measures the annual change in the area of forested land. Change is measured as the number of hectares (ha) increases or decreases in forested land and as the percentage increase or decrease in the area of forested land[32]. The overall assessment of

[32] A range of common definitions have been used in this study. National statistics may in some cases used the same ones, and yet in others slightly different ones; there may be some differences therefore for some of the numbers in this report to some national reports – in the ENPI national assessments where there is a clear difference these are noted to help avoid confusion:

Forest: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use. (FAO, 2010)

Other Wooded Land: Land not classified as "Forest", spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds *in situ*; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use. (FAO, 2010)

change includes both forest loss due to removal of trees and forest gain due to replanting. It should be noted that a net zero loss in forest cover (replanting the same area as is deforested in a given year) may not necessarily lead to no net loss of value to the country, as the stock and flow of products and services from the lost forest and gained forest are often different.

Forests play an important role in the global carbon cycle for their ability to absorb carbon dioxide and store carbon in biomass. While forests serve as a net carbon sink, deforestation and forest degradation can be a substantial source of greenhouse gas emissions. The issue of carbon storage (stock) and sequestration (flow) is gaining in global prominence which will lead to increasing market/payments for avoided carbon emissions from deforestation and forest degradation (Karousakis et al 2011). The quantitative and the monetary assessment focuses on these benefits, i.e. on the value of carbon stored in forest biomass, as this is perceived as a figure easy to understand and communicate to policy makers/the wider public. The quantitative assessment focuses on benefits in terms of the quantity of carbon captured by the existing forest, as well as the potential avoided loss in case of reduced deforestation. As for the monetary assessment, the value of the benefits related to the carbon captured by existing forest today and in the future (potential for sequestration) has been estimated using a high and low Euro value for carbon, based on recent literature.

It should be kept in mind, however, that the biodiversity value of forests goes well beyond their capability of storing carbon, and is intrinsically related to their flora and fauna and the quality of the habitat, which could not be taken into account in our calculations. Forests in fact provide multiple functions, including goods and services such as timber, food, fodder, medicines, provision of fresh water, soil protection, cultural heritage values and tourism opportunities – leading to significant environmental, health, social and economic benefits (MA 2005,TEEB 2008, 2009a; 2009b,2010; 2011).

Box 6.8 presents a range of examples to illustrate the value of forests; there have been very few studies in the ENPI South region, hence the examples are from third counties).

Furthermore, forests are also important for the conservation of species, habitats and genetic diversity, which have a value in their own right ('intrinsic values'), irrespective of the benefits that they provide to human populations.

Qualitative insights on the broader set of benefits have been noted to complement the analysis when information was available.

Deforestation: includes activities such as conversion of forest to agricultural land, conversion for urbanisation, illegal logging *etc.* Forest may also be degraded by fire, pests and storms which can lead to their eventual loss. When considering factors driving deforestation, the likelihood of these degradation factors increasing/decreasing should also be considered

Box 6.8 Forest Ecosystem Services – seeing the whole picture

Forests in different forms cover an area of around 4 billion hectares2 (30.3 per cent of total global land area) and contain 80 to 90 per cent of the world's remaining terrestrial biodiversity. They provide many valuable goods and services, including timber, food, fodder, medicines, climate regulation, provision of fresh water, soil protection, carbon sequestration, cultural heritage values and tourism opportunities. It has been estimated that around 1.1 billion people depend on forests for their livelihoods and that 1.6 billion people around the world depend to some degree on forests for their livelihoods.

Forests as a carbon sink: Standing forests are an important net carbon sink. Old-growth tropical forests are estimated to absorb up to 4.8Gt CO_2 per year, equivalent to around 0.67t CO_2 per capita. Globally, carbon stocks in forest biomass decreased by an estimated 0.5Gt a year in 2000 to 2010, mainly due to a reduction in total forest area. This is assumed to amount to approximately 15 per cent of annual human-induced CO_2 emissions. Conversely, deforestation releases CO_2, into the atmosphere and, at current rates, may account for 18 to 25 per cent of global CO_2 emissions.

Wider ecosystem services: as noted above forests have value not just for their provision of food, fibre and fuel, their contribution to climate regulation (by carbon storage, sequestration, and effects on local climates), but also for a wide range of services that can be reduced with degradation or loss in conversion / deforestation.

Also new forests will generally have lower service provision than loss old growth forest, and mono culture plantation forests can have a very restricted range of services. Examples of values of forests are noted below. As there are few studies in the ENPI East area (which itself could usefully be addressed), a range of other examples are noted - to illustrate the benefits.

Box 6.8 Forest Ecosystem Services – seeing the whole picture

Service	Value
Food, fibre and fuel	Provisioning services for Cameroon's forests (per hectare average discounted net present values) were estimated at US$560 for timber, US$61 for fuelwood and US$41–US$70 for non-timber forest products (NTFPs) (Lescuyer, 2007, based on a review of previous studies). Tribal communities living in the Rajiv Gandhi National Park derived 4691 rupees per household per year from NTFPs (Ninan et al, 2007).
Climate regulation	Value of climate regulation by tropical forests in Cameroon at US$842–US$2265 per ha (Lescuyer, 2007, based on a review of previous studies). Value of carbon stored in above-ground biomass in Guyana's forests, estimated at between $6500 and $7000 per ha at $20 per tonne, but could rise to over $20,000 per ha at potential values of $60–80 per tonne in near future (Office of the President Republic of Guyana, 2008).
Water regulation	Value of flood protection by tropical forests in Cameroon estimated at US$24 per ha/year (Yaron, 2001).
Groundwater recharge	Contribution to groundwater recharge of a 40,000ha tropical forest watershed in Ko'olau, Hawaii, estimated at (net present value (NPV) using shadow prices) US$1.42–2.63 billion (Kaiser and Roumasset, 2002).
Pollination	Average value of pollination services provided by forests in Sulawesi, Indonesia, estimated at €46 per hectare. Due to ongoing forest conversion, continued decline of pollination services is expected to directly reduce coffee yields by up to 18 per cent and net revenue/ha by up to 14 per cent within 20 years (Priess et al, 2007).
Existence values	A contingent valuation study in the UK and Italy evaluated non-users' willingness to pay (WTP) for a proposed programme of protected areas to conserve Brazilian Amazonia at $US43 per household per year (Horton et al, 2003). The value of natural forest in the Herbert River District, North Queensland, was estimated through choice modelling at AUS$18 per ha/year (approximately US$11) (Mallawaarachchi et al, 2001).
Opportunity cost	The value of land use lost by NOT deforesting, on average, is approximately $1000 per ha (present value over 30 years, Grieg-Gran, 2008), varying with geographical and economic details. The values of ecosystem services lost by deforestation (see above) will very often exceed this. In particular the climate regulation values are likely to be higher. Office of the President Republic of Guyana (2008) suggests that the cost of carbon abatement via side-payments to avoid deforestation would be only $2–11 per tonne of carbon dioxide.

Source: From ten Brink et al (2011a) in TEEB (2011) and references therein

For carbon values, we focus on stock values, and note also the value of avoiding potential losses – especially in those countries were deforestation is not currently an issue, but where it will be important to protect and well manage the existing forest in order not to lose its existing value. Overall, the carbon values (See Box 6.9) are here estimated with a relatively simple procedure applicable to all countries, therefore it has not been possible to take into account local specificities and tailored assumptions. The figures provided should therefore be seen as a general illustration of the potential carbon value of forests, providing an order of magnitude rather than a precise estimate, and hopefully offering a useful starting point for future country-tailored analyses.

Box 6.9 Estimating carbon values

There is no single estimate for the cost of CO_2 but rather a range of estimates dependent on what is measured (e.g. cost of achieving a target, or level of damage due to climate change to avoid), the model used and the assumptions made (e.g. level of trading, use of CDM), the type of values taken into account (traded values or non-traded values) and timescale. Care is needed as regards whether the cost of 'carbon' (C) reduction or of 'carbon dioxide' (CO_2) reductions is being quoted. Carbon weighs 12/44 CO_2.

A range of values was used for this ENPI assessment. European Commission values (EC 2008 and DECC 2009) were adopted as the lower value for 2010 and 2020, and the values from a study by the French Centre d'Analyse Stratégique (2009) as the upper range. These are summarised in the table below. These were considered to provide a fair range that also reflects work in the UK, World Bank and other estimates (see second table). These values are higher than the current values in the EU-ETS market. While at first sight this could lead some to argue that lower carbon values should be used, it should be noted that the benefits of action to address climate change are fundamentally linked to avoided damage; the current carbon market prices are considered significantly below the expected marginal damage costs, therefore using them would lead to a potentially significant underestimate in the benefits of addressing climate change. Indeed, even the use of costs of action lead to underestimates of the benefits of action.

For the project, common carbon values were adopted across all countries. These were applied in different parameters: for emissions savings from increased RES and from methane capture, and from avoided emissions from deforestation and degradation. The former two areas are generally in the domain of traded emissions; for degradation and deforestation this is still under debate/negotiation. For the sake of simplicity and without suggesting that carbon saved from avoided deforestation and degradation would be traded and fungible with other carbon, a common CO_2 value was used.

Table 6.4 Carbon value used in this study (€/t)

GHG	Range	2010	2020
Carbon dioxide (CO_2) or CO_2 equivalent	Low	€ 17.2	€ 39
	High	€ 2	€ 5

Table 6.5 Range of values for CO_2 from international studies (a selection)

	Date	2009 GBP	€/tonne CO_2
New Carbon Finance	May-09	36.8	46.1
DB Researc	May-09	34.9	43.8
Barclays Capital	May-09	28.	3.1
Société Général	May-09	27.3	34.2
European Commission	IA 2008 (for 2020)	31.	39.0
DEC (UK)	Latest: core	25.1	31.5
	low	14.2	17.8
	high	31.3	39.3
French government	value for 2010		32
	value for 2020		56

EC (2008); DECC (2009); and Centre d'analyse stratégique (2009).

6.3.2 Current status in the region

Forest cover in the ENPI South region as a whole is at just under 2 per cent of the territory; the highest level is 13 per cent in Lebanon, 11.5 per cent in Morocco, 7 per cent in Israel and 6.5 per cent in Tunisia. Syria has just over 2.5 per cent forest cover. All others have less than 1 per cent forest coverage[33]. Egypt has the lowest percentage coverage at less that 0.1 per cent of territory being covered by forest (see Table 6.6).

Deforestation is not currently an issue - at a **net** national level - in the region, with the exception of Algeria according to FAO data (however national data suggest net deforestation is less of an issue). In most countries there has been an increase in the overall forest area over the 20 year period - for example in Israel, Egypt and Tunisia. There are, however, concerns of deforestation at local levels and associated issues of degradation across the region. Furthermore, a loss of a hectare of old growth forests generally implies a far greater loss of ecosystem services (carbon stored, water retention and storage) and biodiversity than afforestation of new growth achieves – so the actual benefits of avoiding deforestation are more widespread and significant than average net national data would suggest. New growth or regeneration not only does not fully offset losses of old forest, but also, in some countries, may not allow natural regeneration, due to inappropriate management practices, leading to increasing degradation and fragmentation. For instance, the reforestation rate in Morocco is considered below the optimal rate (15 to 20 per cent for maintaining a functioning level of ecosystem services).

While the current ENPI has focused on ENPI wide comparable data, building on FAO, future research is clearly needed on national and local data at both gross and net changes.

Deforestation is currently an issue (at a net national level and according to FAO data) only in Algeria which lost 180 thousand hectares over the period of 1990 to 2010, an annual loss of around 0.6 per cent. In other countries the overall picture is not one of deforestation; on the contrary in most countries there has been an increase in the overall forest area over the 20 year period - for example in Israel, Egypt and Tunisia. This does not mean that deforestation is not an issue at all, as on a local level a loss of forest can lead to loss of important ecosystem services (of implications locally and potentially also nationally, for the region and globally). New growth and lost old growth forests can also lead to losses of services (including carbon storage). Furthermore, past long term trends may not reflect recent trends (see Israel case after the table) or future pathways.

Table 6.6 presents the net change in forest area; see the country reports for more details on what is behind these numbers.

[33] OPT value has been estimated at 1.5% but the data appear less robust.

Table 6.6 Forests coverage and change in coverage 1990 to 2010

	Level of forest coverage - 2010		*Past Forest cover - 1990*	Change in forest area 1990 to 2010	Deforestation (afforestation) rate (p.a. 1990-2010)
	% of territory	Hectares	Hectares	Hectares	%
Algeria[34]	0.63%	1,492,000	1,672,000	-180,000	-0.57%
Egypt [35]	0.07%	70,000	44,000	26,000	2.35%
Israel	7.12%	154,000	132,000	22,000	0.77%
Jordan	1.11%	98,000	98,000	0	0.00%
Lebanon	13.39%	137,000	131,000	6,000	0.22%
Morocco	11.50%	5,131,000	5,059,500	71,500	0.07%
OPT	1.50%	9,000	8,910	90	0.05%
Syria	2.67%	491,000	479,000	12,000	0.12%
Tunisia	6.48%	1,006,000	643,000	363,000	2.26%
ENPI South[36]	**2.0%**	**8,588,000**	**8,267,410**	**320,590**	**0.25%**

Source: own calculations based on http://www.fao.org/docrep/013/i2000e/i2000e.pdf

The deforestation issues in Algeria are due to the fact that Algerian forests are very susceptible for fire, due to summer droughts in combination with heavy winds, and the fact that they are mostly softwoods, more susceptible to fires. The majority of forest fires are caused by humans – some accidentally (Abdelguerfi, 2003b).

The long term trend in Israel has been of afforestation - due to its maintaining an extensive afforestation programme, which dates back more than a century. The number of trees in the area increased from less than 5 million trees in 1948 to more than 200 million trees today, adding some 90,000 ha of forest cover. Another 16,000 ha are currently slated for the development and conservation of forests. However, since 2005 the trend has been towards deforestation. The national annual deforestation rate from 2005 to 2010 was 0.13 per cent (Butler 2010). But due to the 2010 fire, Mount Carmel's forests decreased by nearly 16 per cent this past year.

Forests play a range of functions – most have multiple use, but a range have been designated specifically for production (particularly in Algeria, Tunisia and Morocco), for the protection of soil and water (particularly Libya and Jordan, but also Algeria, Egypt and Tunisia and, to a less though still significant extent, in Lebanon and Israel. A range of forests are also designated for the conservation of biodiversity – up to 18 per cent in Israel and 12 per cent in Algeria and Morocco (see Table 6.7 below). The many designations underline the

34 The Algerian Direction Générale des Forêts estimates the forest cover as 1.7m ha. The above table uses FAO data (FAO 2011), a common source across countries to facilitate ENPI wide analysis. Forest cover area values are sensitive to definitions as regards forest cover definitions.

35 National sources point to a larger forest area of 193,100 ha (Eshet et al. 2009). See Israel country report.

36 As noted above, this excludes Libya

points made above as regards multiple eco-system services from forests. The protection of soil and water is not surprisingly an important rationale for designation – as forests have important water storage, provisioning and purification functions (MA 2005, TEEB 2010, TEEB 2011).

Table 6.7 Forests primary designated functions

Function	Production	Protection of soil and water	Conservation of biodiversity	Social services	Multiple use	Other
Algeria	35	53	12	n.d.	0	0
Egypt	2	49	3	0	46	0
Israel	0	15	18	3	64	0
Jordan	0	98	1	1	0	0
Lebanon	6	25	3	0	66	0
Libya	0	100	0	0	0	0
Morocco	21	0	12	0	67	0
OPT	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Syria	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Tunisia	24	41	4	0	32	0

n.d. = no data

Source: http://rainforests.mongabay.com/deforestation/

6.3.3 Potential environmental improvements

In order to assess the benefits related to forestry, an ENP study wide 'no net loss by 2020' target was set (to allow comparability across nations). As noted earlier, this target is inspired by the commitments made at the recent CBD-COP10 in Nagoya Japan in 2010. As noted in the CBD Strategic Plan Target 5:

> *By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasibility brought close to zero, and degradation and fragmentation is significantly reduced.* (CBD 2010; see also ten Brink et al 2011b)

This ENP wide target calls for a reduction in the annual incremental reduction of the current deforestation rate to 0 per cent by 2020. The analysis therefore aims to identify the benefits that achieving this reduction can bring.

If the target is met, the rate of deforestation will gradually fall until it reaches 0 in 2020. Although some forest will be inevitably lost in the next decade, its size will decrease at a lower rate than the current one, and finally stabilize in 2020.

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

6.3.4 Benefits of reducing deforestation/conserving forests – qualitative assessment

While the benefits of reducing deforestation, and indeed of avoiding deforestation or degradation of forests tend to be very site specific and dependent on the interactions between the forest ecosystems and the social and economic infrastructures/systems (see country reports for examples as well as TEEB 2010, 2011), there are generally some common benefits from forestry (even if the scale/extent of these depends on context). These are given in Table 6.8 below and complement the earlier discussion on ecosystem services.

Table 6.8 Overview of key benefits of avoiding deforestation/degradation

Health benefits	Forests promote health and well-being through their use for recreation and relaxation.
Environmental benefits	A number of environmental benefits are associated with forest land. Forest eco systems have significant ecological functions, in particular soil and water protective, anti erosion, climate regulating and conservative functions. Benefits include: ○ provision of habitat for animal species diversity and ecosystem. For example, forest coverage provides valuable habitat for endemic species ○ regulating services, such as: ▪ provision of clean air/ carbon storage: forests iimprove air quality, especially in the summer when air quality is often compromised, by lowering temperatures, filtering dust, and absorbing ozone, carbon monoxide, sulphur dioxide, nitrogen oxides, airborne ammonia, and heavy metals and by releasing oxygen. The carbon sequestration mitigates the negative effects of climate change, ▪ soil protection and water regulating functions are often critically important: ▪ protection of agricultural land against soil erosion: the washing out of fertile soil can result in significant damage to agriculture. ▪ water conservation: Forest soils are more absorbent than agricultural soils because of higher organic matter content, and tree trunks, branches and leaves intercept as much as half of the precipitation falling on the forests in Georgia play an important water conservation role. By slowing the rate at which rainwater runoff flows to surface water bodies, so that it can be absorbed into the ground, forests help filter pollutants and sediment from waters (quality improvement) while replenishing aquifers (and thus a drinking water source) and keeping annual stream flows steady. ▪ flood control: forest reduce flooding and low flow events by intercepting runoff and encouraging infiltration. ▪ coastal protection. ○ Supporting services: ▪ Soil improvement: The plants enrich the soil by recycling the nutrients through the shedding of leaves and seeds.
Economic benefits	– Forests sustain livelihoods. Forests provide wood and non-wood products that are used and marketed especially by rural communities that, due to their economic situation, are forced to secure their food supplies by growing their own vegetables, keeping livestock, fishing and hunting. Specific examples include the provision of:

Table 6.8 Overview of key benefits of avoiding deforestation/degradation	
	– timber: – non-wood forest products, such as game, berries, nuts, mushrooms, fruits of wild plants and medicinal plants: – Carbon trading: Economic benefits may arise from carbon trading as increased forest area could enhance the carbon sink provided by the national forest area. The level of enhancement will depend on the type, age and additional area of forest conserved. Large areas of degraded farmlands could be reforested and used as green investment under the Kyoto Protocol. – Tourism/recreation revenues: Tourism could constitute an important form of forest use in Georgia, but should be developed in a sustainable manner. Political conflicts strongly reduced tourists flow in the country.Well managed forests attract visitors and hence increase revenues from tourism/recreation. – Job creation: management of forest for amenity provision or biodiversity conservation generates employment opportunities. – Forests increase property values.
Social benefits	– Benefits here include provision of amenity for recreation, education (forests provide outdoor classrooms), tourism, cultural heritage. – Forests provide an opportunity for healthy community action and involvement

An example of the benefits of improved forest management based on the Moroccan experience is shown in the box below.

Box 6.10 The benefits forest in Morocco

Forests cover approximately 7.2% [37] of the Moroccan territory and shelter two thirds of plants and one third of animal species (though only 3% of the forests is protected). The reforestation rate is well below the optimal rate (15 to 20%) for maintaining a basic, functioning level of ecosystem services and current management practices do not allow natural regeneration. Forests have been suffering a disturbing degree of degradation for several years, e.g. fragmentation, the undergrowth is overgrazed and soils have become more vulnerable to water erosion. The forests play an important social and economic role, with an estimated contribution of 5% to the gross national agricultural product and 1% to the total gross national product. Moreover, the rural population's way of life depends to a large extent on material benefits drawn from forests, e.g. 17% of national fodder production and 10 million m³/year of fuel wood (i.e. three times more than the natural production capacity) and timber. The most important contribution of Moroccan forests to the national economy is certainly protection of the environment, especially the protection of soil from erosion, the preservation of water resources in catchment areas and the reduction of siltation in dams. It will be important for the country not to degrade the existing forests in order not to lose the current benefits. Some constraints to sustainable forest management and some conservation measures taken are outlined above. *(FAO, 2003):*

[37] This used a different definition of forest coverage than the FAO statistics used as the core data for the cross ENPI analysis.

6.3.5 Benefits of reducing deforestation/conserving forests – quantitative assessment

Carbon storage: ENPI South' forests contain 328 million metric tons of carbon in living forest biomass, according to 2010 estimates (see tables below), equivalent to 1202 million tCO2. According to 2000 estimates, the 'average hectare' of forest stores on average 38[38] tonnes of carbon, i.e. 140 tonnes of CO_2 – the actual level will naturally vary significantly from site to site, and also with general variations across nations depending on the bio-climatic conditions and state of forestry. Note also that significant levels of carbon are also found in the soil and litter, so these carbon values used here should be seen as a conservative figure. In the event of deforestation or degradation it is not only the living carbon that can be released but also the 'dead carbon' (MA 2005, TEEB 2011, Keith et al 2009). Note that this 'nuance' is in fact quite a vital one, as there are vast quantities of methane (a powerful green house gas) captured in the soil - deforestation, degradation of climate change would each potentially lead to significant methane release and hence an increase in global warming.

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

According to the FAO 2010 report, the world's forests store more than 650 billion tonnes of carbon, 44 per cent in the biomass, 11 per cent in dead wood and litter, and 45 per cent in the soil. However, for this assessment we limit ourselves to what is stored in biomass. The ENPI South region contributes very substantially to this global total, particularly given the Russian forest contributions to global carbon stocks.

Further to this The Economics of Ecosystems and Biodiversity (TEEB) shows that to halt forest degradation and deforestation is an integral part of both climate change mitigation and adaption when focusing on 'green carbon'. Forests are further useful to preserve due to their huge range of services and goods they provide to local people and the wider community (TEEB, 2009; TEEB 2010; TEEB 2011; MA 2005).

As noted above, meeting the ENPI wide target of halting deforestation by 2020 will (at a net level and where based on projections building on 1990-2010 values as noted in FAO data) only appear a relevant target for Algeria – with the potential to save above 180 thousand hectares of forest in the next decade compared to the business as usual scenario. This would correspond to a net saving of about 11 million tonnes of CO_2 in living forest biomass. Had deforestation been halted at 2010 levels abruptly, rather than gradually, the carbon benefits would have been higher – 14 million tonnes CO_2.

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

Table 6.9 Comparative assessment for million tonnes of CO_2 stored under BAU and target scenarios. In million tonnes of CO_2 (mtCO2)

Year	Carbon stored (in million tonnes of CO_2 equivalent) in living forest stock - 2010	BaU: 2020 – if 1990-2010 trend continued to 2020	Projected Change mtCO2	Target 2020: halting deforestation trend in 2020	Net saving from halting deforestation mtCO2	Net saving relative to 2010 reference point
Algeria	257	243	-14	253	11	14
Egypt	25	32	7	n/a	n/a	n/a
Israel	18	19	1	n/a	n/a	n/a
Jordan	9	9	0	n/a	n/a	n/a
Lebanon	7	7	0	n/a	n/a	n/a
Morocco	809	815	6	n/a	n/a	n/a
OPT	1	1	0	n/a	n/a	n/a
Syria	43	44	1	n/a	n/a	n/a
Tunisia	33	42	8	n/a	n/a	n/a
ENPI South	***1202***	***1,210***	***9***	***n/a***	***11***	***14***

Source: Own Calculations based on http://rainforests.mongabay.com/deforestation/2000/Georgia.htm adapted from (FAO, 2011a).

6.3.6 Benefits of reducing deforestation/conserving forests – monetary assessment

The monetary assessment in the ENPI country wide analysis has focused on the value of carbon stored/sequestered in forests and the value of avoiding the loss of forest carbon. As noted above in the introduction on ecosystem services, there are many wider benefits of forests. Box 6.11 presents some examples of valuations that have been done in Israel and also a case example. IT is shown as there is a new momentum and commitment (strategic plan of the CBD, recall chapter 1) to assessing the value of natural capital.

By using a monetary (high and low) value for carbon, as identified in recent studies, it is possible to monetise the value of the amount of carbon currently stored in the forests' living biomass, as assessed above. Assuming a value of CO_2 of €17.2 /ton (low) and €32 /ton (high) in 2010, the value of the carbon currently stored by the ENPI South forests ranges between 21,000 and 39,000 million €. This is the value of the carbon stored in the living biomass today. By 2020, the stock of carbon in living biomass - assuming projected carbon values of €39 /ton (low) and €56 /ton (high) – would suggest values of €47 to €68.5 billion. In Algeria, under the halting forest loss by 2020 target, between €400 and €600 million of potential carbon losses could be avoided. This is summarised in the Table 6.10 below.

In other ENPI countries, the 'halting deforestation target' does not apply when looking at the national totals, hence to underline the benefits of forests as carbon store an estimate has been made of the projection in carbon value from the continued growth of forests – this has been estimated to lead to a carbon gain of €670 to €970 million for the ENPI South region. Beyond this indicative example, the benefits of afforestation have not been explored in this study, and the values will vary depending on whether the afforestation is 'natural afforestation' or 'plantation forests'. Both can be beneficial in terms of carbon storage and also for other ecosystem services such as soil and water retention. The wider range of

biodiversity benefits and ecosystem service benefits will depend on the approach – natural afforestation tends to offer greater biodiversity benefits and wider mix of eco-system services than plantations. Ideally afforestation would adopt sustainable practices, taking into account the implications for other neighbouring habitats (e.g. avoiding the introduction of invasive alien species) and, to the extent possible, by using native rather than imported species.

Note that this is a stock value and not an annual value of carbon sequestered[39], so care is needed when looking at carbon savings from renewable energy technologies, which offer savings every year (See later section). Note also that these values are total values; strictly speaking the carbon values applied are more suited to marginal changes than total stock values (as if all stock were to be lost, the marginal value itself would change); nevertheless the calculated values are important as indicators of the climatic importance of not losing the forest cover.

[39] Annual carbon sequestration from existing forest stocks depend on a number of features (maturity, type of forest, whether living and non-living carbon are included, management practices, climatic conditions) – these have not been calculated separately for each country; the FAO statistics that formed the basis of this analysis gave carbon stock values.

Table 6.10 Estimated value of carbon storage in 2010 and 2020 (high and low estimate)

	CO_2 stored in forest stock (living carbon)* mtC02	Value of carbon storage * 2010 € million (stock value)		Value of carbon storage * 2020 *with trend in forest cover and forest carbon from 1990 to 2010 continued to 2020 and with 2020 carbon prices* € million (stock value)		Value of halting deforestation - avoided CO_2 emissions from stock loss to 2020 € million (change in value of carbon stock)		Value of continued gains in carbon storage - if historic trends continue till 2020 € million (change in value of carbon stock)	
	2010	Low @17.2 €/tCO2	High @ 32 €/tCO2	Low @ 39 €/tCO2	High @56 €/tCO2	Low @ 39 €/tCO2	High @56 €/tCO2	Low @ 39 €/tCO2	High @56 €/tCO2
Algeria	257	4,422	8,228	9,886	14,196	414	594	n.a.	n.a.
Egypt	25	437	813	1,051	1,509	n.a.	n.a.	199	286
Israel	18	301	560	696	999	n.a.	n.a.	41	59
Jordan	9	148	276	336	483	n.a.	n.a.	n.a.	n.a.
Lebanon	7	112	209	256	368	n.a.	n.a.	4	6
Morocco	809	13,915	25,888	31,606	45,383	n.a.	n.a.	167	239
OPT	1	18	33	40	57	n.a.	n.a.	0	0
Syria	43	743	1,383	1,690	2,427	n.a.	n.a.	16	23
Tunisia	33	571	1,062	1,370	1,967	n.a.	n.a.	250	358
ENPI South	1,202	20,668	38,451	46,931	67,389	414	594	677	973

Source: own calculations based on FAO (2011) data

Beyond this indicative example, the benefits of afforestation have not been explored in this study, and the values will vary depending on whether the afforestation is 'natural afforestation' or 'plantation forests'. Both in principle (depending on approach) can be beneficial in terms of carbon storage and also for other ecosystem services such as soil and water retention. The wider range of biodiversity benefits and ecosystem service benefits will depend on the approach – natural afforestation tends to offer greater biodiversity benefits and wider mix of eco-system services than plantations. Ideally afforestation would adopt sustainable practices, taking into account the implications for other neighbouring habitats (e.g. avoiding the introduction of invasive alien species) and, to the extent possible, by using native rather than imported species.

Note that this is a stock value and not an annual value of carbon sequestered[40], so care is needed when looking at carbon savings from renewable energy technologies, which offer savings every year (see later section). Note also that these values are total values; strictly speaking the carbon values applied are more suited to marginal changes than total stock values (as if all stock were to be lost, the marginal value itself would change); nevertheless the calculated values are important as indicators of the climatic importance of not losing the forest cover.

Box 6.11 forest services valuation for the Carmel Forest, Israel

There is also a relatively rich literature on other services provided by Israel's forests and the associated economic values (see Eshet et al. 2009 for a brief overview). During the last 40 years, about 15 academic studies have assessed the economic value of forests from different angles, focussing e.g. on their value for biodiversity, tourism, recreation, use-value of natural resources, their passive-use value, and on forest policy and management. Many of these studies have focused on two of the largest and most iconic forests in Israel, the Carmel forest (with some 3,000 ha) and the Biria (2,000 ha) (see case study below on the economic values of the Carmel forest).

Overview of current conditions

Mount Carmel, a typical Mediterranean forest area near Haifa in north-western Israel. UNESCO has described the mountain as, 'rich in its biological, geological and geomorphologic diversity with contrasting landscapes, a mixture of agricultural areas and prehistoric and archaeological sites (The MAB Programme 2002).'From 1978–2006, there were nine large forest fires in the region and more than 350 smaller ones (Tessler 2008). Both the September 1989 fire in the main recreation area of Mount Carmel and a small nearby fire in 2005 have been subject to extensive research. The conclusions of past research are now informing the response to Israel's worst-ever forest fire that raged on Mount Carmel from December 2-5, 2010, burning nearly five million trees on 40 km2. The tragedy caused 44 deaths and 17,000 evacuations (Environment News Service 2010). As Joel Greenberg of the Washington Post observes, 'The devastation has raised questions about the place and management of forests in a drought-plagued Middle Eastern country in an age of global warming. And it has forced a reassessment of traditional tree-planting efforts long seen by Israelis and Jewish contributors abroad as part of a national mission to 'make the wasteland bloom' (2010).'

[40] Annual carbon sequestration from existing forest stocks depend on a number of features (maturity, type of forest, whether living and non-living carbon are included, management practices, climatic conditions) – these have not been calculated separately for each country; the FAO statistics that formed the basis of this analysis gave carbon stock values.

Monetary assessment
The basis for the monetary assessment comes from a paper by M. Schechter, B. Reiser and N. Zaitsev titled 'Measuring Passive Use Value: Pledges, Donations and CV Responses in Connection with an Important Natural Resource' which was published in Environmental and Resource Economics in 1998. The study focused on the 1989 Carmel fire, which, albeit smaller, resembled the 2010 fire. The conclusions regarding the willingness-to-pay to rehabilitate the forest and invest in fire prevention measures are applicable today because the two scenarios are quite similar.
Schechter et al. used estimated the total value of Mount Carmel (including passive use) to be €140 million, in 1993 prices. The value today is probably even higher due to inflation, the large extent of the 2010 fire, and the rise in GDP since 1989. The study also provided a useful comparison: the price per unit of park area was twice as high as some agricultural land in the centre of Israel (Schechter 1998).

Israel spends €11.4 million on operational expenditures in the forest sector (Forestry Department 2010). The cost in damages from Mt. Carmel Forest fire was over €40 million. And portions of the burned area will be unusable or have limited public access for years.

No data on the change in risk of forest fire was available.

6.4 Level of land degradation

6.4.1 Introduction

Agricultural crop land degradation is widespread in many countries of the world including in the ENPI countries. Benefits of a reversal of crop land degradation or, in other words, an improvement in cropland quality are assessed in this section. A target for improvement in cropland quality to be achieved by year 2020 is specified, direct and indirect benefits of crop land improvements are discussed qualitatively, and direct benefits in terms of increased value of crop production are quantitatively assessed. Definitions of key terms used are presented in the Box below.

Box 6.12 Definition of key terms - cropland

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

6.4.2 Current status in the region

Agriculture share of GDP in the ENPI South countries averaged about 9 per cent in 2008, ranging from less than 2 per cent in Israel to 20 per cent in Syria. Area harvested was about 27 million hectares. Cereals constituted 56 per cent and 'other crops' 44 per cent of total area harvested, but area harvested of 'other crops' was larger than that of cereals in over half of the countries. Area harvested per capita ranged from as little as 0.03-0.05 hectares in Israel, Jordan and the West Bank and Gaza to 0.43 hectares in Tunisia (see Table below).

Table 6.11 Area harvested and agricultural share of GDP, 2008

	Area harvested (million ha), 2008			Area harvested (ha/capita), 2008	Agricultural share of GDP, 2008
	Cereals	Other crops	Total		
Algeria	2.50	1.30	3.80	0.11	6.9%
Egypt	3.00	2.80	5.80	0.07	13.2%
Israel	0.09	0.22	0.31	0.04	1.6%
Jordan	0.05	0.13	0.18	0.03	2.9%
Lebanon	0.07	0.21	0.28	0.07	5.3%
Morocco	5.40	1.85	7.25	0.23	14.6%
Syria	3.00	1.77	4.77	0.23	20.0%
Tunisia	1.10	3.30	4.40	0.43	9.9%
OPT	0.04	0.15	0.18	0.05	5.8%
ENPI South	15.24	11.72	26.96	0.14	8.9%

Source: Area harvested is estimated based on linear trends using FAO reported data from 1995-2008 due to annual fluctuations in area harvested (FAO 2011). Agricultural share of GDP is from World Bank (2010) and UN Stats.

Much of agricultural crop land in the ENPI South countries suffers from degradation. But systematic and nationwide data are scarce. One exception is the Global Assessment of Soil Degradation (GLASOD) survey data presented in FAO (2000).[41] The national territory is classified into five categories: land that is non-degraded, and land with light, moderate, severe and very severe degradation. According to these data, human induced land degradation ranges from about 40 per cent of the national land area in Egypt and Israel to 100 per cent in Lebanon and Syria (Table 6.12). However, 84-100 per cent of the population in the countries lives in or around degraded land. Main identified types of degradation are chemical deterioration and wind erosion, but also water erosion in several of the countries. Main identified causes of degradation are agricultural activities, overgrazing and deforestation. Box 6.13 illustrates the land degradation problems and its causes in Algeria, Jordan and Egypt.

41 GLASOD collated expert judgement of soil scientists to produce maps of human induced soil degradation. Using uniform guidelines, data were compiled on the status of soil degradation considering the type, extent, degree, rate and causes of degradation within physiographic units (Sonneveld and Dent, 2007). Sonneveld and Dent (2007) note that the GLASOD data do not necessarily represent consistent classifications of land degradation across countries. Cross-country economic assessments are therefore not necessarily comparable.

Table 6.12 Extent of human induced land degradation

	% of national land area			% of population living on or near degraded land		
	Degraded	Light & Moderately degraded	Severely & Very severely degraded	Degraded	Light & Moderately degraded	Severely & Very severely degraded
Algeria	56%	35%	21%	96%	38%	58%
Egypt	38%	30%	9%	84%	20%	64%
Israel	43%	43%	0%	99%	99%	0%
Jordan	96%	65%	31%	99%	35%	64%
Lebanon	100%	75%	25%	100%	75%	25%
Morocco	96%	76%	19%	100%	81%	18%
Syria	100%	40%	60%	100%	41%	59%
Tunisia	79%	0%	79%	98%	0%	98%
OPT*	80%	61%	19%	99%	70%	30%

Source: FAO (2000). * FAO does not provide data for the occupied Palestinian territory. Area degraded is an average of the neighboring countries Israel, Jordan and Lebanon.

Box 6.13 Land degradation in some of the ENPI countries

Algeria

Land in Algeria suffers from several forms of degradation. In the useful agricultural areas, salination affects mainly the irrigated plains located in the western part of the country where some soils are completely sterilized and have reached an irreversible level of degradation, particularly in the regions of Mina, Habra and Sig. A few oases are also concerned. The non controlled irrigation and the lack of maintenance of drainage network led to the rising of ground water tables and the increase and spread of salinity. The affected area is in the order of 50,000 ha.

More than 80 per cent of rangelands are degraded or very degraded. The increasing number of livestock is the main reason for this degradation. According to a study conducted by the High Commissariat for the Steppe Development (HCSD), the production of the steppe in the year 1978 was 1.6 billion FU (feed unit), equivalent to about 100 – 120 FU/ha. This estimate is confirmed by an earlier study (by Le Houerou, in the mid fifties). Due to degradation and desertification, the production in 2000 did not exceed one third of that amount. Thus over thirty years, the steppe has lost 1.2 billion FU of its natural production. The potential cost of this loss is about DA 16.9 billion per year (PPP €292 million) if a feed unit is valued at the world price of barley. Thus recovering 50% of this production loss by proper management of the rangelands could provide a benefit of DA 8.5 billion per year (PPP €146 million). The Algerian High Commission for Development of the Steppe has recently initiated a program of regeneration of the steppe over an area of 3 million hectares through deferred grazing and fodder plantations.

Jordan

Most land areas in Jordan are degraded to varying degree. For instance, in the Ajloun Highlands, improper farming practices that accelerate soil erosion, woodland and forest cutting, land fragmentation and uncontrolled expansion of urban and rural settlement are the major causes of land degradation. Soil erosion is also contributing to sedimentation of reservoirs, reducing their storage capacity and useful lifetime, thus contributing to water scarcity.

Box 6.13 Land degradation in some of the ENPI countries

The declining productivity of rangeland is a major issue in Jordan. Rangelands are a cornerstone in the livelihood of most of Jordan's rural poor. It is reported that there has been a drop of about 50% in rangelands' productivity in the last decade and a half mostly due to overgrazing and refugee inflow whose livestock in addition to the local flocks have led to overstocking of grazing lands. The rangeland carrying capacity decreased by 70% over the last seventy years. Small ruminants in Jordan nowadays depend on imported feed for half their food requirements. Natural grazing supplies only 25-30% of their requirements given the decline in productivity of grazing lands. The Jordanian authorities take active measures toward the creation of rangeland reserves and rehabilitation of degraded plots.

Egypt

About 84 per cent of the Egyptian population lives on or around degraded land, mainly in Nile valley and delta. Currently, the main type of human induced land degradation is chemical deterioration of the soil, largely caused by agricultural activities. Climate change is expected to have a strong negative impact on productivity in the upcoming years. The projected changes in crop production (compared to the current status) of some major crops in Egypt in 2050 under a temperature increase of 2 °C will be: change in rice production by -11 per cent, maize by -19 per cent, soybeans by -28 per cent , Barley by -20 per cent and cotton will increase by +17 per cent (Abou-Hadid, 2008).

Source: See the ENPI benefit assessment country reports.

6.4.3 Potential environmental improvements

Target to be reached by 2020

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

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

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

- First, crop yield reductions resulting from current levels of land degradation must be assumed. Plausible reductions applied here are presented in Table 6.13 using a 'low', 'medium' and 'high' scenario.[42]

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

- Second, the GLASOD data do not allow for crop specific yield effects. It is therefore assumed that all crops cultivated in each land category suffer from the same yield reduction.

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

Table 6.13 Assumptions of current crop yield reductions on degraded land

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

Source: Assumptions by the authors.

Baseline to 2020

Baseline tons of crop production must be projected to year 2020 from reference year 2008, assuming business-as-usual (i.e., no change in crop land management practices). Baseline crop production is then compared against estimated crop production resulting from achieving the target in year 2020 (see above) through better crop land management.

Baseline projections in crop production from 2008 to 2020 are presented in Table below. Projected annual change is based on linear trends in production of cereals and other crops from 1990 to 2008 using data from FAO (FAO 2011). The projected change in production reflects changes in both areas harvested and crop yields.

Table 6.14 Projected baseline annual change in crop production, 2008-2020

	Cereals	Other crops
Algeria	2.1%	2.8%
Egypt	2.2%	2.4%
Israel	0.0%	0.0%
Jordan	-4.2%	1.8%
Lebanon	3.1%	-0.9%
Morocco	-0.2%	1.5%
Syria	0.7%	2.0%
Tunisia	-1.4%	1.8%
OPT	1.9%	0.0%

Source: Estimates by the authors.

Projections in real crop prices to year 2020 must also be made in order to estimate the monetary benefit of improvement in crop land quality.[43] It is assumed that real prices of

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

cereals and 'other crops' will increase at annual rate of 4 and 3 per cent, respectively. Crop prices may be expected to increase at a faster rate to 2020 than prices of other goods and services in the economy. The FAO world food price index increased by 33 per cent and the FAO world cereals price index increased by 31 per cent from the 2007-2010 average index value to the January-February 2011 average index value (FAO 2011). However, the large price increases of cereals and foods observed during 2006-2008 and again in 2010 are likely to be off-set by future periods of decline in prices as experienced during 1999-2003 and again in 2009. Thus the projected real price of cereals is assumed to increase at a rate of 4 per cent per year and the real prices of other crops at a rate of 3 per cent per year to 2020. The crop prices in reference year 2008 to which these price increases are applied are FAO reported international commodity prices for cereals and FAO reported producer prices for other crops in each of the countries.[44] International commodity prices for cereals are applied because they better reflect the real economic value of internationally traded crops, such as cereals, than domestic producer prices of these crops.

Improvements achieved by reaching the targets

The improvements of reaching the target by 2020 are the difference between crop land quality with no change in crop land management practices and crop land quality with improved land management practices. This difference is assumed to result in an increase in crop yields equivalent to half of the crop yield losses from current levels of land degradation (*see Target to be reached by 2020*). Improvements in crop land management practices may also be expected to have many other benefits (see below).

The GLASOD data do not map crop areas harvested by the categories of land degradation used in Table 6.13. Assumptions about distribution of crop areas harvested must therefore be made. Two distribution options are used here:

1. Crop areas harvested are distributed in proportion to land area in each land degradation category.
2. Crop areas harvested are distributed in proportion to population distribution across the land degradation categories.

The first option assumes that crop area harvested is uniformly distributed across the country. Clearly this is a special case and highly unlikely because of forests, mountains and uncultivable desert/arid areas. The second option assumes that hectares of crop area harvested per population are the same everywhere. This may be close to the case if the whole population were rural and employed in agriculture.

Estimates of yield increases from meeting the target in 2020 are presented in the table below.[45] 'Low', 'medium' and 'high' refer to the scenarios of yield losses from land

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

[45] Yield increases from meeting the target in 2020 is first estimated for each of the two distributions of crop areas harvested, using the data in Tables 2-3. The mean of the yield increases of the two distributions is then used for the benefit estimation of meeting the target.

degradation in Table 6.13. The largest expected yield increases are in Jordan, Syria and Tunisia.

Table 6.15 Estimates of yield increase from meeting the target in 2020

	low	medium	high
Algeria	5.0%	7.0%	9.1%
Egypt	3.9%	5.1%	6.3%
Israel	2.1%	2.3%	2.6%
Jordan	7.2%	10.6%	14.4%
Lebanon	4.2%	5.2%	6.1%
Morocco	5.5%	7.9%	10.6%
Syria	7.9%	11.2%	14.9%
Tunisia	7.7%	10.7%	14.2%
OPT	4.4%	5.8%	7.3%

Source: Estimates by the authors.

6.4.4 Benefits of reducing cropland degradation – qualitative assessment

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

Table 6.16 Benefits of improved crop land management	
Health benefits	– Soil erosion control can reduce agro-chemical run-offs which can help reduce pollution of water sources used for drinking and bathing, and thus contribute to protection of health. – Improved soil nutrient management can reduce the need for chemical fertilizer applications and thus reduce nitrate pollution of surface and groundwater resources used for drinking.
Environmental benefits	– Soil erosion control can reduce soil run-offs and sedimentation of rivers and lakes. Sediment: ○ causes turbidity in the water that limits light penetration and prohibits healthy plant growth on the river bed. ○ can cover much of a river bed with a blanket of silt that suffocates life. ○ is an important carrier of phosphorus, a critical pollutant which causes eutrophication. – Soil erosion control and improved soil nutrient management can reduce the need for and run-offs of agro-chemicals and thus reduce water pollution. – Improved crop land management can prevent land becoming degraded to the extent that it is abandoned (e.g., severe erosion or salinity, physical or chemical soil degradation). Thus, in some countries, improved land quality can contribute to reduced desertification.

Table 6.16 Benefits of improved crop land management	
	– Improved crop land management can help counteract the foreseen negative effects of climate change on agriculture productivity (e.g. in Egypt), and hence represent an effective adaptation measure
Economic benefits	– Improved crop land management enhances agricultural crop yields through improved physical and chemical soil properties and reduced salinity and erosion. – Erosion control reduces sedimentation of reservoirs and dams used for irrigation, municipal water supply, and/or hydropower, and therefore increases their useful lifetime. – Reduced agro-chemical run-offs from erosion control may also reduce the cost of municipal water treatment.
Social benefits	Erosion control reduces agro-chemical run-offs and therefore improves quality of water bodies used for recreation.

Source: Produced by the authors.

6.4.5 Benefits of reducing cropland degradation - quantitative assessment

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

The benefits of meeting the target of improvement in land quality that reduces current crop yield effects of land degradation by 50 per cent by 2020 are estimated based on the yield increases in Table 5. The yield increases are multiplied by the estimated value of crop production in 2020. This provide the estimated value of the extra tons of crop production as a result of reducing land degradation and are the annual benefits in 2020 of meeting the target.

6.4.6 Benefits of reducing cropland degradation - monetary assessment

The estimated benefit, in terms of improved crop land quality and increased crop production, totals about €4.9-8.6 billion (PPP) in year 2020 (Table below). The 'medium' estimate ranges from 0.04 per cent of GDP in Israel to 0.6-1.1 per cent of GDP in Egypt, Morocco, Tunisia and Syria. These four countries with the largest benefits as a per cent of GDP are the countries with the largest share of agriculture in GDP.[46]

[46] A regression analysis finds that about 70% of the variation in benefits as a percent of GDP across the ENPI countries is explained by the countries' agricultural share of GDP and the estimated crop yield increase from improved crop land management.

Table 6.17 Estimated annual benefits in 2020 of meeting the target

	Benefits (€, PPP million)			Benefits (% of GDP)		
	Low	Medium	High	Low	Medium	High
Algeria	488	682	889	0.17%	0.24%	0.32%
Egypt	2191	2846	3529	0.47%	0.61%	0.76%
Israel	71	79	87	0.03%	0.04%	0.04%
Jordan	81	118	160	0.22%	0.33%	0.44%
Lebanon	97	118	140	0.20%	0.25%	0.29%
Morocco	684	985	1313	0.51%	0.73%	0.98%
Syria	824	1166	1550	0.78%	1.11%	1.47%
Tunisia	457	642	848	0.56%	0.79%	1.04%
OPT	41	54	68	0.29%	0.38%	0.48%
ENPI South	4934	6689	8583	0.36%	0.50%	0.65%

Source: Estimates by the authors.

A case example on the monetised benefits from reduced cropland degradation in Jordan is presented in the box below.

Box 6.14 Economic benefits of implementing adaptive measures to preserve rainfed staple food in rangeland areas for livelihood and as fodder for livestock in Jordan

- Rainfed agriculture in Jordan is one of the most vulnerable sectors to climate change, as the available water and land resources are limited and most of Jordan's land is arid. A crop simulation model was used to assess the impact of different climate change scenarios on rainfed wheat and barley in the Yarmouk Basin over the 1996-2006 periods. An increase of 1° Celsius by 2020 was retained, which is likely according to various downscaling models with different rainfall scenarios as downscaling models give different seasonal projection ranges for the Yarmouk Basin: -20%, -10%, 0%, +10% and +20%.
- Rainfed wheat and barley had high vulnerability to climatic change of increased air temperature and decreased precipitation with temperature increase affecting barley whereas precipitation reduction affecting both wheat and barley.
- The adoption of soil water conservation to increase available water to crop could be seen as an important adaptation measure to climate change when precipitation was low. Also, the selection of drought tolerant genotypes with shorter growing seasons than the present genotypes is another adaptation measure that should be considered to alleviate the adverse impact of climate change. Also, extension services were to be provided to farmers to change and cropping and harvesting patterns to adapt to climatic variability.
- The 2020 baseline entails the crop yield that is impacted by climate change, which could be translated by the increase of crop failure frequency. The area under study in the Yarmouk Basin is considered constant over the years: 5,220 ha for wheat and 2,160 ha for barley. The 2020 target entails the crop yield that is less impacted by climate change affects as adaptation measures are implemented in terms of change in crop patterns, dry-resistant seeds, and possible supplemental water storage for irrigation when the temperature and the lack of rain will require some selective irrigation. A number of health, environmental, economic and social benefits accrue to the rural population in the Yarmouk Basin study area. The monetary assessment was also calculated reaching €417,139 (PPP) equivalent to about 0.001 % of 2020 GDP. Hence, a replication of the monetisation case to the entire rangeland areas could generate substantive benefits in 2020.

7 CLIMATE CHANGE

Key messages: Climate change

Climate change and mitigation

- The **total CO_2 emissions from energy consumption in the region** amounted to around 475 million tonnes of CO_2 in 2008, or an average of 2.4 tonnes CO_2/capita. There is a wide range across the countries in the region, with per capital emission from energy use going from 1.3 tonnes CO_2/capita/year in Morocco to 8.6 tonnes CO_2/capita/year in Israel, reflecting climate, energy resources and infrastructure, economic activity, and social norms.
- **Renewable energy sources (RES) contribution** to overall gross final energy is currently just under **2 per cent** for ENPI South (excluding OPT and Libya) – it provided 2.1 million tonnes of oil equivalent (mtoe) of a total of 124 mtoe final energy consumption for the region. The RES share in 2008 ranges from less than 1 per cent in Algeria to 8 per cent in Israel (mainly passive solar) and nearly 15 per cent in Tunisia (mainly waste-to-energy). The contribution of RES and in particular to electricity generation is still far from its technical potential.
- **Potential for renewable energies:** The increased uptake of renewable energy sources represents a major potential for the region to reduce GHG emissions as well as address energy security, cost issues as well as having a potential to create new employment and driver of the economy.
- In ENPI South the amount of gross final energy consumption from RES, if no progress were to be made to the ENPI RES target, is estimated at around 2.6 mtoe – using a conservative energy conservation baseline (building on existing RES share). If the 20 per cent ENPI-wide target were met the RES contribution would be 31 mtoe, around 24 mtoe more than in the baseline scenario which would displace other fuel use - fossil and nuclear - at the same share as today's fuel mix..
- **Avoided CO_2 emissions:** An increase of the RES share of gross energy consumption from current levels to 20 per cent is estimated to reduce CO_2 emissions by about 92 million tonnes CO_2 by 2020 – see table below.
- **Value of CO_2 savings:** Assuming a CO_2 value ranging from €39 and €56 per tonne in 2020, the reduced emission from CO_2 estimated above will represent a saving of between €3.5 and €5.25 billion per year in 2020. For the purpose of comparing the results to current money values, if the RES target were to be met today the benefits from reduced emissions would be between €1.5 and €2.9 billion per year given lower carbon prices (€17 and €32 /ton in 2010).
- **Energy efficiency** is not covered in this study, due to data and methodological limitations. It is understood, however, that energy saving and improved technology can

Key messages: Climate change

also be important drivers to reduce GHG emissions, and it is recommended that this is taken into account in future assessments.

Climate impacts and adaptation

- A significant and accelerating trend in mean temperature increase has been identified in the continent. An increase of 0.1-0.3 °C per decade was observed for the period 1960 to 2005, depending on location. By the end of the current century it is estimated that an increase of up to 9 °C may occur for the period June to August in the year.(Boko, M. et al., 2007) Over this century rainfall patterns are likely to change, resulting in dryer summers and winters, but more extreme rainfall events resulting in increased flood risks.
- These trends in climate are projected to result in a wide variety of impacts across sectors in the region and are judged to be overwhelmingly negative. Whilst agricultural crops may benefit marginally from enhanced CO_2 fertilisation effects in some areas, these are likely to be outweighed by water constraints and flooding that both reduce crop productivity.
- The most common impacts identified across the region are i) constraints on water resources arising from changing rainfall patterns combined with higher rates of evapo-transpiration (e.g. Syria, Egypt), particularly on agriculture, exacerbation of desertification, and access for urban populations; ii), coastal erosion and inundation, and iii) the impacts on infrastructure and other resources as a result of river flooding. The exacerbation of other natural hazards, like forest fires, are also likely (e.g. in Lebanon)
- The potential impacts of climate change on ecosystems and biodiversity, human health, forestry and agriculture are also recognised as being significant.
- The recognition that climate change is occurring and is likely to continue has led to a wide variety of adaptation measures being considered to combat this range of potential climate change impacts. Emphasis is being put on adapting to projected water resource constraints in order to provide security of supply to domestic and industrial users as well as agricultural producers.
- The need for such adaptation is acute given current water stress across this region. The benefits of investment in water supply technologies combined with demand management strategies are particularly important for agricultural producers and urban consumers and are critical to economic development and social stability.

7.1 Overview

All regions of the world face the risk (in some cases already reality) of important man-made climate change impacts and each region has contributed in some way to this climate change (even if at vastly different levels), had the potential to help avoid climate change and adapt

to climate change; two ways of reducing the risks to their region, their countries (IPPC 2007, Stern 2007).

Section 7.1 presents an overview of the type of impacts (that need avoidance or adaptation) and also the scale of the 'responsibility' (put in terms of GHG emissions), which in turn present a scale of opportunity for avoiding emissions.

Section 7.2 presents an important area of action to reduce emissions – renewable energy sources (RES). A growth in RES contribution to energy supply and consumption can lead to significant levels of avoided GHG emissions, and is an integral part of the transition towards a low carbon economy, a critical thread of the wider ambition and need of moving towards a green economy (UNEP 20110, OECD 2011).

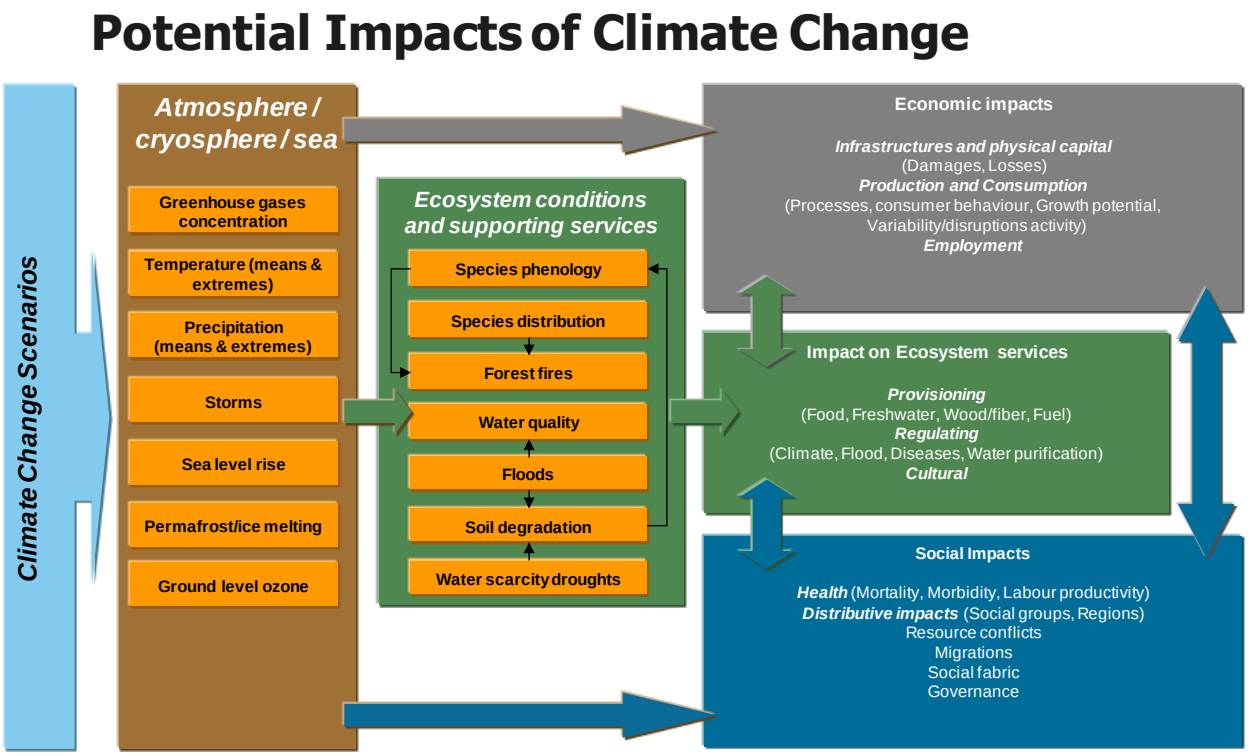
Other important areas of GHG emissions reductions and hence climate mitigation include 'methane capture' from waste landfills and carbon storage and sequestration in forestry – as in chapters 5 and 6 of this report. There is also significant carbon stored more widely in natural capital, whether 'green carbon' (e.g. agricultural soils, grasslands) or blue carbon (e.g. carbon in seas, wetlands) – and measures in these areas will be important for a move to a low climate economy (see TEEB 2010b). Furthermore, there is a vast need for improved energy efficiency in buildings, in transport, in products and process. Actions in each of these areas together stand a chance of mitigating climate change and keeping to the (average) 2 degrees rise that has been proposed as the 'acceptable maximum'.

Even this 'acceptable maximum' is achieved, there will be important risks and important losses and societies will need to adapt to these change. A 2 degree rise may well be too late for many warm water coral reefs (TEEB 2010), but a wide range of adaptation measures can be made which will offer benefits to nations. Section 7.3 presents the issue of climate change impacts, risks and adaptation needs for the region.

Climate change impacts

Figure 7.1 presents an overview of potential impacts from climate change. Climate change will not just be about increased GHG concentrations and temperature rises, but also impacts on precipitation levels (including flooding incidence and drought), storms, sea level rise, risks of permafrost melting. This can affect species, forest fires (e.g. in Lebanon), floods, soil degradation (e.g. in Jordan), water availability (e.g. in Egypt and Syria). There will be impacts on natural capital and the flow of services from this capital, a range of economic impacts and social impacts.

Figure 7.1 Potential Impacts of Climate change Adaptation to Climate Change - Overview



Source: Environment DG based on (EEA, 2008), OECD 2008 and TEEB. ***Potential impacts are*** *all impacts that may occur given a projected change in climate, without considering adaptation (see Section 7.3*

Current status of GHG emissions in the region

The total CO_2 emissions from energy consumption in the region amounted to around 520 million tonnes of CO_2 in 2008, or an average of 2.4 tonnes of CO_2/capita.

When wider emissions are taken into account, then total emissions will be higher as will be per capita emissions.

There is a wide range across the countries in the region, with per capital emission from energy use going from 1.3 tonnes CO_2/capita/year in Morocco to 8.6 tonnes CO_2/capita/year in Israel, reflecting climate, energy resources and infrastructure, economic activity, and social norms.

Table 7.1 CO_2 emissions

	Population	Total CO_2 Emissions from energy use (million tonnes CO_2)	CO_2 emissions per capital from energy supply (TCO2/cap)
	2008	2008	2008
Algeria	34,373,426	88	2.6
Egypt	81,527,172	174	2.1
Israel	7,308,800	63	8.6
Jordan	5,906,043	18	3.1
Lebanon	4,193,758	15	3.6
Morocco	31,605,616	42	1.3
OPT	3,937,309	n.d.	n.d.
Syria	20,581,290	54	2.6
Tunisia	10,327,800	21	2.0
ENPI South	199,761,214	476	2.4

CO_2 Emissions from energy sources from IEA (2008) and IEA (2010) [47]
ENPI South : Region excluding Libya
For total GHG & GHG./capita equiv.: http://unstats.un.org/unsd/environment/air_greenhouse_emissions.htm

The emissions present an indication of the potential scope for measures to reduce emissions. Section 7.2 below presents what benefits are potentially available from increased use of RES and hence avoiding GHG emissions.

7.2 Uptake of renewable energy sources

7.2.1 Introduction

This section focuses on the benefits of increasing the use of renewable energy sources (RES), as these can reduce the amount greenhouse gases (GHG) thanks to the reduction in the consumption of fossil fuels. Whilst the resulting air quality improvements are primarily local and national in scale, the reductions in climate change impacts are assumed to be spread globally. The following definitions apply:

- *Energy from renewable sources:* energy from renewable non-fossil sources, namely: Wind, Solar, Aerothermal (i.e., energy stored in the form of heat in the ambient air), Geothermal (i.e., energy stored in the form of heat beneath the surface of solid earth), Hydrothermal (energy stored in the form of heat in surface water) and ocean energy, Hydropower, Biomass (i.e., biodegradable fraction of products, waste and residues from biological origin from agriculture - including vegetal and animal substances- , forestry and related industries including fisheries and aquaculture, as well as the biodegradable

[47] Note that in this ENPI South regional report the statistics in the tables build on the IEA and 2008 data (where possible); there may therefore be some differences with data in ENPI countries where they have used other sources and dates for data. The core messages stay the same.

fraction of industrial and municipal waste), Landfill gas, Sewage treatment plant gas, and Biogases. (EC, 2009)

- *Gross final consumption of energy*: the energy commodities delivered for energy purposes to industry, transport, households, services including public services, agriculture, forestry and fisheries, including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution and transmission. (EC, 2009) In this report it is calculated as: total final consumption + distribution losses + own use.[48]

The quantification assessment will focus on the environmental benefits related to increased substitution of fossil fuels with RES, resulting in a decrease in CO_2 emissions, if a hypothetical target of 20 per cent RES uptake were to be reached by 2020 (based on EU targets). While this target is currently ambitious, there is potential for a much higher level of RES contribution to domestic energy demand (and indeed for export) in most of the countries in the ENPI South region. For example, in given the insolation levels (sunlight hours and strength) and the area available for solar plant are such that the potential for solar power is significantly greater than 20 per cent. RES, and in particularly solar power offers a major opportunity for new economic development of the region – see Figures below. The potential in ENPI South, from an insolation perspective, is far higher than in countries where RES-solar is already expanding quickly (e.g. Germany). See also country reports.

To assess the monetary value of reduced CO_2 emissions due to the RES uptake, a range of carbon values, based on well recognised studies[49], have been used – as shown in the table below.

Table 7.2 Carbon value used in this study (€/tonne)

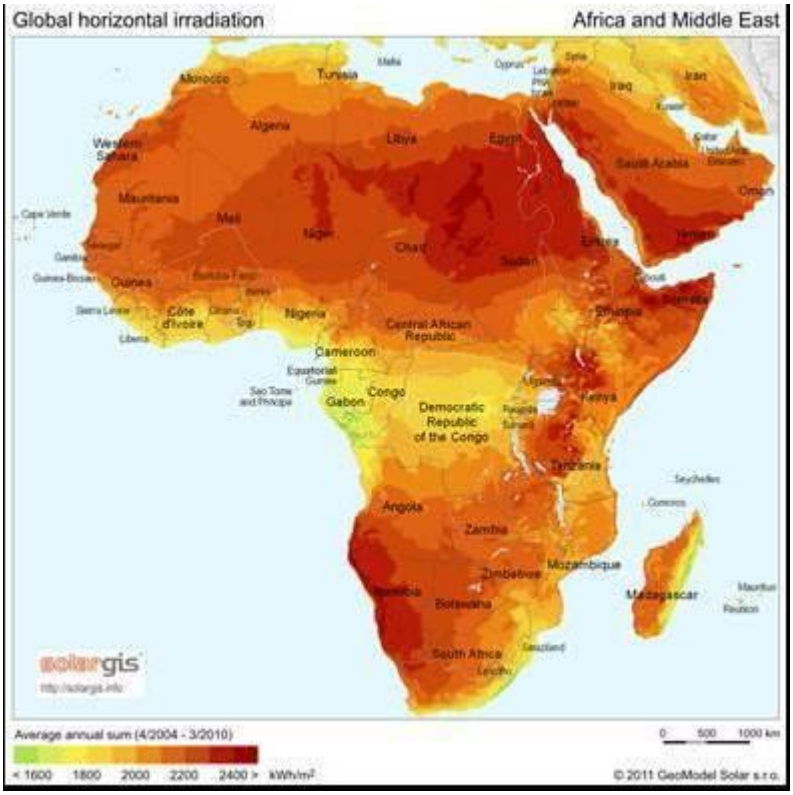
GHG	Range	2010	2020
Carbon dioxide (CO_2) or CO_2 equivalent	Low	17.2	39
	High	32	56

Source: based on data from EC (2008; DECC (2009); and Centre d'analyse stratégique (2009)

48 The analysis of the benefits of avoided CO2 emissions from increasing the share of RES of the ENPI countries energy mix focuses on total final energy consumption and builds on IEA data for the ENPI countries. Some assumptions as regards conversion losses in the electricity, heat and CHP (combined heat and power) were necessary in the calculations to allocate outputs to fuel inputs. This regional report builds on common assumptions for the countries for energy conversion ratios for different fuel types, adopting a more nuanced approach than in the first analysis presented in the country reports. The RES share values are in places slightly higher than the country reports for this reason. This does not change the overall conclusions as regards CO2 savings and is mentioned here for completeness. Note that the BAM (benefits assessment manual) and the supporting spreadsheet tool available to countries have also been revised using an adjustable set of conversion rates, to offer countries a tool that allows for using more country specific assumptions. Countries wishing to do their own analysis can explore the issue further by adapting their assumptions in light of fuller nuanced country-specific information on the electricity, heat and CHP stock (performance efficiency, losses, age), exports and imports of fuels, energy efficiency and demand changes

49 European Commission values (EC 2008 and DECC 2009) have been used as the lower carbon values and, estimates from a French study (Centre d'analyse stratégique, 2009) as the higher values.

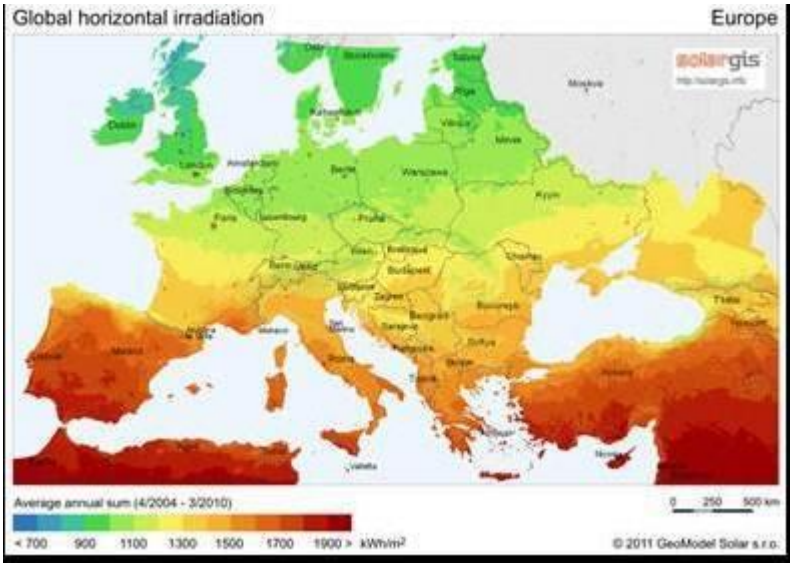
Figure 7.2 Solar insolation map - *Africa and Middle East*



Source: Solagis http://solargis.info/doc/71

Source: Solagis http://solargis.info/doc/71

Figure 7.3 *Comparative map of Europe*



Source: Solagis http://solargis.info/doc/71

7.2.2 Current status in the region

According to EIA data for 2008 (EIA, 2010), the RES contribution to overall gross final energy is currently near 2 per cent for ENPI South – it provided 2.4 mtoe of a total of 124 mtoe final energy consumption for the region. The RES share ranges from less than 1 per cent in Algeria to 8 per cent in Israel in 2008[50] and nearly 15 per cent in Tunisia. Renewable energy share includes both combustible renewable and waste and the 'clean' RES such as solar, wind and geothermal energy. The Tunisian 15 per cent is virtually all waste to energy; for truly renewable sources the share was 0.1 per cent. Israel's 8 per cent is mainly solar power, and nearly all passive solar water heating; a contribution to electricity generation while it has great technical potential, still lies well below 1 per cent.

Table 7.3 RES share in ENPI South – related to energy use

	Population	Total primary energy supply (TPES)	Total Final consumption (TFC) (excl. losses)	Total CO_2 Emissions from energy use in 2008		current share of RES in TFC in 2008	
	2008	2008	2008	mt CO_2	tCO_2/cap	ktoe	%
Algeria	34,373,426	37,069	23,447	88	2.6	57.1	0.2%
Egypt	81,527,172	70,710	48,300	174	2.1	2,626	5.1%
Israel	7,308,800	22,009	13,149	63	8.6	1,075	8.0%
Jordan	5,906,043	7,061	4,437	18	3.1	119.0	2.5%
Lebanon	4,193,758	5,242	3,561	15	3.6	177	4.9%

[50] IEA data; Israel Central Bureau of Statistics, 2006 – give value at 5.5% (earlier year)

Morocco	31,605,616	14,977	11,313	42	1.3	619	5.4%
OPT	3,937,309	1,402	1,272	-	-	-	-
Syria	20,581,290	19,701	12,099	54	2.6	235	1.9%
Tunisia	10,327,800	9,178	6,576	21	2	994	14.7%
ENPI South	**199,761,214**	**187,349**	**125,154**	**476**	**2.4**	**2,371**	**1.9%**

Own calculations based on IEA Statistics – e.g. http://www.iea.org/stats/balancetable.asp?COUNTRY_CODE=BY

7.2.3 Potential environmental improvements

In order to calculate the baseline situation in 2020 it is assumed that energy consumption will change proportionally with the change in population (i.e., more people, more energy consumed), and that the share of fossil fuels and RES over total final consumption will remain as the actual levels (as a percentage), unless there are clear indications for a baseline rise (this is explored in the country reports). It is also assumed that by 2020 the same amount (in kilo tonnes of oil equivalent - ktoe) of combustible renewable and waste will remain the same as today. These are of course all assumptions to help arrive at an estimate of the potential benefits that should prove an indication of the potential benefits.

In our baseline, the gross final energy consumption in 2020 if energy consumption stays the same per capita (a very conservative estimate as regards demand; optimistic as regards energy efficiency gains offsetting overall growth in demand driver by economic growth and income growth) will be of about 157 mtoe for ENPI South. The gross final energy from RES will be about 2.6 mtoe or about 1.6 per cent for the region as a whole (with significant variations). Note that in the country studies, sensitivities on baselines are taken, to allow not just a benefit assessment versus the status quo RES share, but also incremental benefits as regards baselines. The former (results presented here) useful to underline the benefits of action from today; the latter (with respect to an increasing RES baseline; see country studies), gives benefits of incremental, additional action.

Table 7.4 Baseline in 2020 for energy consumption

	Total Current gross final energy consumption	**Current population**	**Current gross final energy consumption per capita**	**Estimated gross final energy consumption in 2020**	**Baseline Gross final energy consumption from RES in 2020**	**Share of RES over total in 2020**
	Ktoe	*million*	*toe/ capita*	*ktoe*	*ktoe*	*%*
Algeria	23,447	34.37	0.68	32,749	**68**	0.21%
Egypt	48,300	81.53	0.59	61,603	**3,146**	5.1%
Israel	13,149	7.31	1.80	16,037	**1,288**	8.0%
Jordan	4,437	5.91	0.75	5,733	**143**	2.5%
Lebanon	3,561	4.19	0.85	4,355	**212**	4.9%
Morocco	11,313	31.61	0.36	13,774	**741**	5.4%
OPT	1,272	3.94	0.32	no data	no data	no data-
Syria	12,099	20.58	0.59	14,609	**282**	1.9%
Tunisia	6,576	10.33	0.64	8,091	**1,191**	14.7%

ENPI South	124,154	199.76	0.62	156,951	**2,569**	1.6%

To assess the potential environmental improvements, this 'business as usual' baseline scenario is compared to a theoretical target of at least 20 per cent of gross final consumption of energy obtained from RES by 2020. This target is inspired by EU Directive 2009/28/EC requiring mandatory national targets for the overall share of RES in gross final consumption of energy of 20 per cent by 2020. It is understood that this can be an ambitious target to reach by 2020 for some countries and easy for others. It has been nevertheless useful to provide an estimate of the benefits to be gained from an ideal improvement.

The environmental improvement consists on the increase in the uptake of renewable energy if the 2020 targets are reached. In ENPI South the amount of gross final energy consumption from RES if the target were met is estimated at 31 mtoe. This represents an increase of about 24 mtoe from the baseline scenario, and leading to an equivalent reduction of fossil fuel consumption. Naturally some of these 24 mtoe will come from existing plans and strategies.

Table 7.5 Reduced amount of fossil fuel use

	Gross final energy consumption in 2020	RES baseline share	RES target share	RES @target s share (20% unless otherwise noted	Reduced amount of fossil fuels /increased RES
	ktoe	%	%	ktoe	ktoe
Algeria	32,749	0.2%	20.0%	6550	**6,481**
Egypt	61,603	5.1%	20.0%	12321	**9,175**
Israel	16,037	8.0%	20.0%	3207	**1,920**
Jordan	5,733	2.5%	20.0%	1147	**1,004**
Lebanon	4,355	4.9%	20.0%	871	**659**
Morocco	13,774	5.4%	20.0%	2755	**2,014**
OPT	-	-	20.0%	-	-
Syria	14,609	1.9%	20.0%	2922	**2,640**
Tunisia	8,091	14.7%	20.0%	1618	**427**
ENPI South	**156,951**	**1.6%**	**20.0%**	**31390**	**24,319**

7.2.4 Benefits of increasing the uptake of RES – qualitative assessment

Environmental benefits: Increasing the amount of energy produced from RES, and hence reducing GHG national emissions will help tackling climate change. Since official reports stress that Egypt is one of the countries most hit my climate change, especially the river Delta, Egypt is also arguably one that can most benefit from climate change reduction.

Health benefits: A reduced consumption of fossil fuels can help improving air quality by reducing emissions related to fossil fuel combustion that can lead to pulmonary diseases. The benefits of improved air quality are discussed in section 7.1.

Economic benefits: An increased uptake of RES can increase energy security, thanks to increased diversification of sources and increased national production. Employment opportunities can also be created in the RES sector (e.g. for production, installation and maintenance), and lead to possible cost savings in energy production (on a case by case level – e.g., wind energy in some areas may result cheaper than renovating/building new power plants).

Social benefits: The use of RES is helpful to provide energy to isolate locations not connected to the electricity grid. Furthermore, contributing to mitigating climate change will be beneficial for the wellbeing of citizens living in cities more exposed to sea level rise, like Alexandria, and will help avoiding relocations.

7.2.5 Benefits of increasing the uptake of RES – quantitative and monetary assessment

An increase of the RES share of gross energy consumption from 1.9 per cent to 20 per cent is estimated to reduce CO_2 emissions by about 92 million tonnes CO2 by 2020 – see table below. Assuming a CO_2 value ranging from €39 and €56 per tonne in 2020, the reduced emission from CO_2 estimated above will represent a saving of between €3.5 and €5.1 billion per year in 2020.

For the purpose of comparing the results to current money values, if the RES target were to be met today the benefits from reduced emissions would be between €1.5 and €2.9 billion per year given lower carbon prices (€17 and €32 per tonne in 2010).

Table 7.6 Value of CO_2 reduced emissions – avoided emission in 2020 and carbon values for 2010 and 2020

	Reduced amount of fossil energy use if target met in 2020	Reduced amount of CO_2 emissions if target met in 2020	**CO_2 value in 2020 (€/tonne CO_2)**		**Monetary benefit M€/year in 2020 (2020 values)**	
	Mtoe	mt CO_2	low	**high**	Low	**high**
Algeria	6.48	20.93	39	**56**	816	**1,172**
Egypt	9.17	32.7	39	**56**	1,276	**1,832**
Israel	1.92	9.84	39	**56**	384	**551**
Jordan	1.00	3.96	39	**56**	154	**222**
Lebanon	0.66	2.90	39	**56**	113	**162**
Morocco	2.01	7.79	39	**56**	304	**436**
OPT						
Syria	2.64	12.02	39	**56**	469	**673**
Tunisia	0.43	1.54	39	**56**	60	**86**
ENPI South	**24.3**	**91.7**	**39**	**56**	**3,576**	**5,135**

The monetary assessment focuses on the benefits related to the decrease in CO_2-emissions. The total annual monetary benefits from reduced emissions due to increased uptake of RES has been estimated at €3.6 to €5.1 billion for the year 2020 based on the lower and higher carbon price scenarios and relative to the baseline that has RES growing from 1.9 per cent to

20 per cent over the period. The benefits over the period 2010 to 2020 would start and increase as progress is made to the 2020 target. After 2020 the renewable share will continue to lead to benefits of avoided CO_2 savings over the operational lifetime of the technology and further investments in RE technology.

Box 7.1 Interpreting the results

These results can be seen as a relatively 'quick scan' or scoping analysis with the aim of deriving a value that could be a useful indication of the scale of potential benefits achievable.

The numbers have been conservative on the side of the expectation of energy demand growth – as we have used population figures. And they have been conservative as well as regards the use of the baseline as regards RES share. **A more detailed and fuller analysis would likely have overall higher CO_2 savings from RES that the above results,** given that energy demand was likely to understated by more than the RES share in 2020 was understated. Countries can naturally derive their own results by factoring their assumptions as regards population changes, GDP changes, energy efficiency gains, structure changes to the economy, energy supply and demand mix and hence overall energy demand, as well as shares of RES growth in the plan, in likely implementation and hence what benefit there are from RES plans, and what potential there are beyond this.

7.3 Climate change adaptation

7.3.1 Introduction

This section identifies benefits from adapting to climate change. The overall objective is to identify potential impacts from climate change (recall Figure 7.1), before identifying measures – known as adaptation – that may be expected to reduce these impacts, and so provide benefits. The emphasis is on climate change impacts that are likely to be detrimental – rather than beneficial - to human well-being.

It should be noted that many of the benefits identified and assessed in this report for other parameters, are common to this section. For example, water resources may be further threatened under climate change futures. In this case, measures that alleviate pressure on water resources are also likely to reduce climate change-induced water resource pressure. However, since climate change exacerbates the pressure, it is implied that to fully respond to the pressure, additional economic resources will be needed.

Adaptation can be defined as adjustment in natural or human systems in response to actual or expected climatic change or its effects. The purpose of the adjustment is to reduce harm- or risk of harm - or to exploit beneficial opportunities associated with climate change. Various types of adaptation can be distinguished, including anticipatory (before impacts are observed) and reactive (after impacts have been felt) adaptation, private and public adaptation, and autonomous (action from individuals, households, businesses and communities) and planned (the result of deliberate policy decisions) adaptation. In most circumstances, anticipatory planned adaptations will incur lower long-term costs and be more effective than reactive adaptations. Adaptation measures are practical initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects, such as raising river or coastal dikes moving human settlements out of flood plains, the substitution of more temperature-shock resistant plants

for sensitive ones, etc. Some are man-made technological solutions (e.g. building dikes or sea walls), while others are ecosystem based adaptation measures (making use of natural flood planes, or investing in resilience of ecosystems, including protected areas[51]).

Adaptation benefits are the avoided damage costs or the accrued benefits following the adoption and implementation of adaptation measures. One can distinguish between potential impacts and residual impacts. Potential impacts are all impacts that may occur given a projected change in climate, without considering adaptation. Residual impacts are the impacts of climate change that would occur after adaptation.

Different countries and systems have different adaptive capacity, i.e. a different ability to adjust to climate change or to cope with the consequences. Adaptive capacity is often assumed to relate closely with: level of economic development (GDP/capita); availability of technologies, infrastructure, institutions and education. Vulnerability depends on climate change exposure, sensitivity, and adaptive capacity.

7.3.2 Current status in the region

The main impacts of climate change are projected to occur on human and natural systems in future decades. Consequently, this environmental theme is understood to have more relevance when considering future time periods rather than the present day. However, there is some evidence from the ENPI South countries that weather patterns in recent years have changed in ways consistent with those expected under current climate change scenarios for future time periods. For example, in Egypt, the mean maximum and minimum temperatures over the last 40 years has increased by 0.34^0C and 0.31^0C per decade, respectively (see also the box below). In Syria in the Levantine basin the sea level has risen by 20mm per year over recent years. The frequency of extreme weather events, particularly summer heat waves and spring storms, has also increased in recent decades in the OPT.

Given that the emphasis is on future climate change, the project has surveyed expert judgement in ENPI countries as to their views on the most important climate change impacts likely to affect these countries. The findings of this survey are summarised in Table 7.7. Whilst it should be emphasised that the differences in the depth of information available in each country precludes the findings from individual countries from being compared in detail, the table does serve to highlight common themes within the region. First, it is clear that there are a wide range of climate change impacts identified across the ENPI South countries arising from changes in climatic means and variability, (temperature and precipitation), as well as sea-level rise. Second, there is a clear emphasis in this assessment – explicitly highlighted in seven countries - on the constraints on water resources arising from changing rainfall patterns combined with higher rates of evapotranspiration. The effects of decreasing water resources are identified as being on domestic and industrial use, the negative impact on agricultural productivity, and the spread

[51]The UN Framework Convention on Climate Change (UNFCCC) recognizes the value of ecosystem resilience (Article 2) and introduced the term 'ecosystem-based adaptation' at its COP14. (TEEB 2011). Better-managed, better connected, better-governed and better-financed PAs are recognized as key to both climate change mitigation and adaptation. (TEEB 2011)

of desert areas across these countries. These impacts are recognised as exacerbating currently observed trends and pressures. Third, sea level rise is also emphasised in the countries with significant lengths of coastline.

Box 7.2 Temperature rise in Egypt

Temperature increases can have damaging effects to human health and biodiversity, and affect economic activities, particularly those related to agriculture. Climate change studies predict a reduction in the productivity of two major crops in Egypt: wheat and maize, by 15% and 19% respectively by 2050. It should be noted this would be due not only to temperature rise, but to the combined effect of crop-water stress, pests and disease, and the inundation and salinisation of 12-15% of fertile land in the Nile Delta as a result of seal level rise and salt water intrusion. Temperature rises are likely to increase crop-water requirements thereby directly decreasing crop water use efficiency and increasing irrigation demands of the agriculture sector. Crop water requirements of the important strategic crops in Egypt are expected to increase by a range of 6 to 16 per cent by 2100. Temperature rise will also have negative impacts on the marginal agriculture and increased desertification rates. Additionally, temperature increases are expected to have adverse effects on livestock and fish production and lead to bleach coral reefs.

7.3.3 Benefits of climate change adaptation – qualitative assessment

A sample of the variety of benefits of adopting adaptation measures in the region include those listed in the table below.

Table 7.7 Qualitative description of benefits of adaptation to climate change

Environmental benefits	**Description**
Ecosystem condition improvements	– Climate change adaptation through conservation efforts will ensure that species, habitats and ecosystems are maintained, especially those that are particularly vulnerable to temperature changes (e.g. coral reefs) – Flood and coastal management practices introduced in response to climate change will also help protect vulnerable habitats. – Pro-active forest management strategies are being developed to protect the diversity of wood species and composition of forests; as well as the accessibility of forests for population recreation purposes and the role of forests in fire control.
Health benefits	**Description**
Lower incidence of acute health impacts	– The introduction of heat warning systems in urban areas should be effective in reducing the mortality and morbidity consequences of vulnerability to heat-waves. – Disease monitoring systems may be used to contain the spread of vector-borne diseases that may spread as a consequence of flood events or changes in temperature vectors.
Social benefits	**Description**
Improved quality of life	– Reduced health effects – Investments in water, soil and coastal restoration for adaptation purposes may help to improve community well-being and provide new opportunities for employment and recreation. – The process of identifying and implementing adaptation at a

Table 7.7 Qualitative description of benefits of adaptation to climate change	
	community or wider level may serve to generate greater social cohesion, and adaptive capacity per se.
Economic benefits	**Description**
Protect current production.	– Adaptation to the threats to agricultural yield from water scarcity and temperature increase, through more efficient management practices and equipments/technologies (e.g. drip irrigation) would result in some protection of farm incomes and local economies. – Crop rotation and more targeted application of fertilisers may also support yield levels, provided that overall use do not increase (indeed can decrease with proper targeting and dosing) and environmental impacts are duly taken into account.
Exploit new opportunities	– Increase in tourism and associated expenditures in local areas. These tourism benefits will be realised if, for example, coastal protection and management reduces the threat to coastal amenities – benefits could be obtained from preventing damage to infrastructure in the coastal zone, especially if future land-use planning takes into account modelling of sea level rise.

In the Table 7.9 below, the coverage of benefits to climate change adaptation, as highlighted in the survey undertaken, is summarised by country. It is very important to emphasise that the survey asked the national teams to highlight only a small number of climate change risks, and adaptation benefits, likely to be of most significance in the short-term. Thus, the results tables below do not pretend to be comprehensive in their identification of all notable climate change risks in individual countries.

7.3.4 Benefits of climate change adaptation – qualitative assessment

In Tables 7.8 and 7.9 below, the coverage of impacts and benefits to climate change adaptation, as highlighted in the survey undertaken, is summarised by country. It is clear that a wide variety of adaptation measures are already being considered to combat the range of potential climate change impacts. The survey finds that five countries are recognising the importance of adapting to projected water resource constraints. Adaptation measures that are identified are principally in the form of investments in supply and storage infrastructure that increase the efficiency with which water resources can be exploited. These investments would be targeted at domestic and industrial users as well as agricultural producers. The survey also finds that the majority of countries are concerned with the need for greater levels of flood protection. Again, engineering-based solutions – in this case dykes - dominate those adaptation measures being considered in these countries.

Table 7.8 Summary of Identified Climate Change Impacts: ENPI South Countries

Climate Variable	Direct Impact (Sectoral/ Cross-sectoral)	Algeria	Egypt	Israel	Jordan	Lebanon	Morocco	OPT	Syria	Tunisia
Temperature: Means	Ecosystems		X	X				X		
	Energy									
Temperature: Variability	Health		X	X				X		
Precipitation: Means	Water – resources	X	X	X	X		X	X	X	
	Water - desertification	X						X	X	X
	Water – Agriculture	X	X	X	X		X	X		X
Precipitation: Variability	Forest fire				X	X			X	
	Infrastructure/ Floods	X		X						X
Sea Level Rise: Mean	Coasts		X	X		X	X	X	X	X

Table 7.9 Summary of Identified Benefits from Adaptation to Climate Change: ENPI South Countries

Benefit	Source of Benefit	Algeria	Egypt	Israel	Jordan	Lebanon	Morocco	OPT	Syria	Tunisia
Health	Heat wave - respiratory/cardio		X	X						
	Diseases e.g. malaria						X	X		
Environmental	Coastal protection - wetlands & coral reefs		X	X		X	X		X	X
	Forest protection	X		X					X	
	Biodiversity Plans implementation							X		
Economic	Investment in water infrastructure - economic multiplier effects	X								
	Coastal protection - salinisation			X						X
	Investment in water storage &efficiency inc. Ag. production	X	X	X	X		X	X	X	X
	Coastal protection - infrastructure	X	X	X		X		X	X	X
	Tourism benefits - coastal/water resource protection	X	X							X
Social	Coastal restoration - community	X								
	Arising from other categories (Ec., Soc., and Env)		X	X		X				X

Two examples illustrate the fact that monetary benefits of adaptation may be significant. First, in Jordan it is estimated that the monetary benefits associated with forest fire avoided is equivalent to the forgone total economic value of the affected hectares of forest. It is assumed that the area of forest fire avoided in 2020 is 10 per cent ±5 per cent of the level of forest cover in 2008, i.e. between 4,150 and 12,450 hectares. Mid-point benefits are estimated to be €2.25 million (PPP) in 2020 prices equivalent to 0.01 per cent of 2020 GDP.
Second, in Israel, an assessment of the economic costs in the case of a 1 meter sea level rise scenario concluded that at least 8.4 km of coast will be lost by 2060, leading to economic damages of NIS4-5 billion, an equivalent of €62-952 million. The region-wide climate risk of desertification is outlined in Box 7.3 below with the Tunisian adaptation response giving it focus.

Box 7.3 Desertification: Adaptation in Tunisia

Desertification is endangering around half of the areas in Tunisia in which arable cropping, forestry and pasture farming are feasible. Inappropriate forms of land use are causing the soils to lose their fertility. Some areas have been hit by soil salinization and water and wind have eroded the humus layer, with entire human settlement areas being sanded up. Climate change further exacerbates the situation: the average temperature in southern and central Tunisia is predicted to rise by more than 2°C by the year 2050, with precipitation decreasing over the same period. This is projected to result in the loss of a fifth of the land suitable for the cultivation of cereals, as well as half the forested areas. Ground water reserves will be reduced by almost 30%.

In 1998, a National Action Plan to Combat Desertification was incepted, and reinforced in 2005 by setting up the National Commission on Combating Desertification (CNLD). The resulting National Action Plan is the overarching framework unifying the programmes and projects of conservation of natural resources. As part of monitoring the implementation of the national action plan, the CNLD issued several recommendations and guidelines related in particular to:

1. Boosting the efficient management of non-conventional water resources in the agricultural and ecological fields, as well as using all means possible to optimise the re-use of treated wastewater in promoting agricultural production, such as scaling up programmes related to the provision of fodder and pasture, based on tapping the water available at the wastewater treatment plants in Southern Tunisia;
2. Mainstreaming climate change in the preparation of strategies and programmes related to the management of natural resources, while tapping the opportunities offered within the framework of the UNFCCC and the Kyoto protocol (Clean development Mechanism (CDM) and Climate Change adaptation fund (CCAF));
3. Pursuing and sustaining the national programmes and strategies of Water and soil Conservation (CES), and promoting the forestry and rangeland sector;
4. Pursuing the implementation of the regional and local programmes of integrated natural Resources conservation and development;
5. Conservation of the local genetic stock of plant species that are acclimatised with the arid and semi-arid environment, especially grain crops and fodder plants, as well as collection and optimisation of such species and promoting scientific research in this regard;
6. Setting up systems and indicators to monitor and evaluate the efficiency of the programmes of combating desertification and of conservation of natural resources, of which early warning in the field of climate change and the management of natural resources from an adaptation point of view.

Various regions in the country have also developed their own action programs for combating desertification (PARLCD). And local action programs (PALLCD) are also elaborated by numerous communes on a joint basis.

There are also important opportunities for ecosystem based adaptation – working with natural capital to adapt to climate change. This can be cost-effective and can also have useful co-benefits though wider ecosystem service provision and there is arguably more scope for these than the current plans would suggest (see Box 7.4).

Box 7.4 Ecosystem based adaptation

We cannot solve biodiversity loss without addressing climate change and vice versa. We therefore need to look for the 'triple win' of biodiversity that can actively contribute to climate mitigation and adaptation. (ECCHM, 2009)

The UN Framework Convention on Climate Change (UNFCCC) recognizes the value of ecosystem resilience (Article 2) and introduced the term 'ecosystem-based adaptation' at its COP14.

Climate adaptation on the ground cannot and should not be solely addressed through human-made infrastructure (see for example CBD AHTEG, 2009; Campbell et al, 2009; TEEB 2011): on the contrary, climate-resilient development should include ecosystem-based adaptation where appropriate. Well-designed coherent networks of appropriately managed and ecologically connected PAs are one of the most cogent responses to climate change and should be an explicit component of an ecosystem-based adaptation strategy (e.g. Kettunen et al, 2007).

Ecosystem-based approaches can be applied to virtually all types of ecosystems, at all scales from local to continental, and have the potential to reconcile short- and long term priorities (see for example, Blumenfeld et al, 2009). Green structural approaches – e.g. ecosystem-based adaptation – contribute to ecosystem resilience. They not only help to halt biodiversity loss and ecosystem degradation and restore water cycles, but also enable ecosystem functions and services to deliver a more cost-effective and sometimes more feasible adaptation solution than can be achieved solely through conventional engineered infrastructure. Such approaches also reduce the vulnerability of people and their livelihoods in the face of climate change. Many pilot projects in this area are under way (see TEEB 2011 and World Bank, 2009). The experience gained needs to be mainstreamed across countries and regions.

Ecosystems needing special attention in this respect are wetlands and other freshwater ecosystems (e.g. Palmer et al, 2009), forests (e.g. Bonan, 2008) and agricultural systems, where the link between climate change, ecosystem services and human livelihoods is explicit. Agricultural productivity is affected by rising temperatures and increased drought (IPCC, 2007). Agricultural resilience is therefore a key part of adaptation, especially in countries with large populations dependent upon subsistence farming (IAASTD, 2008; Herrero et al, 2010).

Protecting biodiversity and ecosystems – and using them sustainably in the case of culturally modified systems – is the best way to preserve and enhance their resilience and one of the most cost-effective defences against the adverse impacts of climate change. An ecosystem-based approach to adaptation is crucial to ensure ecosystem services under conditions of climate change.

Sources: builds on Chapters 8 and 9 of TEEB 2011.

Box 7.5 Water resources in Jordan

The 2009 Jordan Water Strategy entitled 'Water for Life' for the period 2008-2022 was developed in light of the severe water scarcity that is facing the country with serious impacts on agriculture. The strategy defines the long term goals that the government seeks to achieve in the water sector and it focuses on effective water demand management, effective water supply operations and significant institutional reform. One of the future priorities identified in the strategy is that of addressing drought management and adaptation to climate change through proper policies and regulations.

As the water status is already in significant overdraft, the sector will be highly vulnerable to change towards hotter/drier conditions. Under the best case climate scenario (no change in temperature, precipitation +20 per cent) Jordan would still need to invest in a number of water conservation measures, whilst in a more extreme scenario, (+3.5°Celsius change in mean temperature, precipitation +20 per cent), the projected deficit would be 1,020 million m^3/year, compared with a deficit of 408 million m^3 per year under the no climate change scenario. Options modelled include: water pricing, conservation measures, water distribution network rehabilitation, stricter enforcement of metering, billing and revenue collection, and reallocation through volumetric constraints. Taken together these measures could realise water savings of up to 566 million m^3.

7.4 Conclusions – climate change related benefits

The ENPI region faces increasing pressures from climate change and a response to these pressures includes both contributions to climate mitigation and by strategies and measures to adapt to climate change. Increasing the contribution of renewable energy sources (RES) offers a significant opportunity to reduce greenhouse gas emissions and contribute to avoiding global warming while at the same time supporting objectives of energy security and creating further employment. Climate adaptation will be an inevitable necessity, indeed already a present necessity, and both man-made technological solutions and ecosystem based adaptation approaches merit attention in the region.

8 SUMMARY AND CONCLUSIONS

8.1 Key Messages

Key messages from the work on the benefits of improving the environment in ENPI South in the areas of air, water, waste, nature and climate change, are summarised below.

Key Messages

Key messages from the work on the benefits of improving the environment in the Southern partner countries in the areas of air, water, waste, nature and climate change, are summarised below.

8.1.1 Key Messages: Air

- Air quality is currently a significant environmental hazard across the Southern partner countries, in particular in urban centres, where most of the industries and vehicles are concentrated, resulting in sizeable negative impacts on public health, ecosystems, crops and materials. In Morocco for example, most of the industries are located in the Casablanca region.
- Principal benefits resulting from reduced emission levels of a range of pollutants include: improvements in human health (pulmonary and cardiovascular illness); higher crop yields, (nine crops including potatoes, barley and wheat), and; reduced soiling of building materials. Air pollution impacts on ecosystems and cultural heritage would also be reduced as a result of lower emissions.
- Total emission reductions of SO_2, NOx, PM, NMVOCs and NH_3 by 50 per cent from projected 2020 levels in all the Southern partner countries are presented in Table 1.

Table 1 Air pollutant emission reductions in the Southern partner countries (thousand tonnes)

NH_3	NMVOC	NOx	PM_{10}	SO_2
377	1574	776	731	1322

- As a result of these emission reductions, the total quantified benefits realised domestically as a result of each country's reductions could be as much as €32 billion (in PPP) per year, of which 60 per cent of these benefits – the largest in absolute terms - would be made within Egypt, as a result of the emission reductions in that country. The numbers of premature deaths and cases of chronic bronchitis that could be avoided annually rises up to between 19,000 – 60,000 and 36,000 – 117,000 respectively by 2020.
- According to the indicative estimates made here, a further doubling of benefits could be realised in 2020 if changes in impacts that result outside national borders as a result of domestic reductions were also considered. Benefits to human health are estimated to

account for around 90 per cent of all the quantified benefits, due to reductions in incidence of respiratory and cardio-pulmonary illnesses.

- These results therefore suggest that – as being initiated in many of these countries – future regulation should address both stationary and non-stationary sources and consider technological options as well as spatial planning.
- Air quality strategies are likely to be more cost-efficient if they are designed to exploit synergies that exist with climate change policies that regulate greenhouse gas emissions. Such synergies should therefore be recognised in the design of national and regional environmental policies.

8.1.2 Key Messages: Water

- Provision of a centralised piped drinking water supply varies across the Southern partner countries. For urban populations, the highest levels of provision are found in Israel, Egypt and Lebanon and the lowest are in Algeria and the OPT. For rural areas, there is more variation between the Southern partner countries. In Israel almost all rural populations are connected, but in some countries connection rates are low, such as in Algeria and Syria. In Morocco, the share of the rural population that uses improved drinking water sources has hardly increased over the past decades, though progress is being made recently.
- The level of household connection to the sewage network also varies. In some urban areas this can be relatively high, such as in Israel, Algeria and Syria, but some urban populations are not well connected. For instance in the peri-urban areas of Morocco's main cities, about 2 million Moroccans have no access to water supply and/or sanitation services. For rural populations the degree of connection to sewage networks is much more diverse, ranging from 100 per cent connection in Israel, to only 4 per cent in Jordan. Many of the poorest people remain without any form of sanitation. These deficiencies directly affect people's health and their ability to engage in income-generating activities—or, for children, to attend school
- Information on the status of hygiene practices is generally not available in most countries. However, substantial improvements in hygiene practices can be achieved in most countries with substantial reduction in diarrheal disease and transmission of respiratory infections.
- Meeting targets of full connection to piped drinking water and sewage collection would mean an additional 45 million people would have reliable and safe piped water to premises, and an additional 92-106 million people would have connection to a sewage network system in 2020.
- Overall, across the region, the benefits that would accrue from improved drinking water quality, sewage connection, and improved hygiene practices would be between 45 million and 100 million annual cases of diarrhoea avoided and between 4,350 and 9,500 deaths avoided in 2020.
- The annual monetised benefits that would accrue from improved drinking water quality and sewage connection and improved hygiene practices would be between €2.1 billion and €4.7 billion for morbidity, between €1.7 billion and €3.7 billion for mortality, which

would give total annual benefits of between €3.8 billion and €8.4 billion. These benefits represent between 0.06 per cent and 0.99 per cent of the individual countries' GDP in 2020. These values are in € PPP.

- Wastewater treatment varies across the Southern partner countries, but in many cases treatment plants are often lacking, but in Israel, where there is extensive provision of the service. In some countries sewage is often released directly into the rivers, the sea or on the soil. Improving levels of treatment would reduce pollution of surface waters with benefits for ecosystems and for health through reduction in contamination of drinking water sources and recreational bathing areas.
- Surface water quality varies, with many water courses suffering from pollution, often from old or inadequate wastewater treatment infrastructure, sewage discharges, industrial pollution, and agro-chemical run-offs. Improving this would bring significant benefits for residents and users, such as farmers, fishermen, and property values, etc.
- The benefits of meeting water quality improvements vary between €31 and €240 per household (in PPP) per year, which corresponds to 0.10-0.86 per cent of the GDP of individual countries in 2020.
- Water scarcity is a serious problem across Southern partner countries, given the arid climate and limited water resources. A number of countries, such as Jordan and Syria, have already reached peak renewable water resources, and Egypt is already classify as 'water poor'. Droughts cause significant economic damage and forced rural migration. Better water management, that should precede any water supply augmentation, would bring additional economic, as well as social and environmental benefits.

8.1.3 Key Messages: Waste

- Key waste-related issues include: increasing waste generation (with the improving living standard), a poor waste management policy, lack of cost recovery policies and thus of sufficient funding, lack of technical expertise, insufficient cooperation between municipalities, inefficient and partial collection, inappropriate waste disposal (no sanitary landfills), and a low level of public awareness (evidenced e.g. by widespread littering on beaches) and limited involvement of the private sector (e.g. lack of Extended Producer Responsibility).
- Municipal waste collection coverage is an issue in most Southern partner countries. Only Israel and Lebanon succeed in reaching full or nearly full waste collection coverage, especially in rural areas. Better coverage would avoid wild tipping, unmanaged dumpsites, waste burying and burning, and their related impacts on health and environment. Jobs can be created as well as more viable living conditions.
- A shift from dumpsites to well managed sanitary landfills, including the rehabilitation of abandoned quarries used for waste disposal, would have a considerable environmental impact. Sanitary landfills avoid nuisance, odour, fires and smoke (often with dioxin emissions), runoff water impact, soil water impact and health risks (from methane emissions and from waste scavenging).

- Lack or poor separate waste collection reduces the opportunities for recycling in several countries, and central composting facilities often do not exist. As a result, in most of the country analysed only a minor fraction of the collected municipal solid waste is being recycled. In several countries (e.g. Egypt, Morocco) the informal recycling sector recover valuable waste items before collection or at the landfill sites.

  It is estimated for example that in Morocco (2008) about 3,500 waste-pickers, 10 per cent of which are children, are living on and around the 300 uncontrolled dumpsites, and open dumpsites. Waste pickers inclusion initiatives are now being taken in some of the main cities.

- Recycling would avoid the remaining landfill impacts, generates jobs and makes material resources available for the industry. Sorting at source and adapted collection systems are the first condition to reach high quality recycling. The present informal recycling sector can be professionalised and its activities can grow considerably

- Back yard composting and centralised capital extensive (windrow) composting of source separated material are a good solutions to divert biodegradable waste from landfills, and they create a valuable material to fight soil degradation.

- Biodegrading waste cause the production of methane, a strong greenhouse gas, which escapes from landfills and dumpsites. Avoiding these emissions through enhancing collection coverage and diverting biodegradable waste from dumpsites and landfills is the first and major measure to take when addressing greenhouse mitigation measures in the field of waste policy.

- Complementary methane can be captured on well equipped landfill sites. Captured landfill gas can be flared (oxidising methane to CO_2 and reducing its impact with a factor 25), or it can be used to generate electricity or to be distributed as natural gas. Calculable and monetisable benefit assessments can be made on: surface of avoided dumpsites, amounts of supplementary collected municipal solid waste, amounts of supplementary composted or recycled waste, jobs created for collection and waste treatment, overall value of supplementary sound waste management, based on WTP, and marketable values of avoided CO_2 eq. emissions. This first ENPI wide assessment (using ENPI wide common targets) give the following indicative order of magnitude estimates of the benefits:

    - Enhanced waste coverage will likely lead to significant avoidance of polluted land – this first ENPI South wide estimate suggests that this could be in the order of a 100 thousand m^2 for the OPT to 350,000 in Jordan to millions of m^2 in other countries - 2 million m^2 in Morocco, 3.4 million m^2 in Algeria and around 7.5 million m^2 in Egypt.

    - Increased waste treatment by expanding collection coverage and sanitary landfill capacity could avoid around 35.6 million tonnes of unsanitary waste dumping, lead to 13 million tonnes of additional waste recycled or composted and eight thousand additional jobs generated in the region for landfill, recycling and composting.

    - Overall around 34 million more people could benefit from increased waste collection coverage under the target, leading to around €1.5 billion (PPP) benefits per year for the region.

  - There are considerable potential benefits from improved waste management also for climate mitigation. Over the region around 5.5 billion m^3 of methane could be avoided per year, with a value of around €5.3 billion per year from 2020.
- Through improved waste management national and local authorities can have great potential influence on improving the quality of public health (e.g. by improving collection and treatment), conserve natural resources (through increased recycling) and mitigate climate change (through methane capture). This would require a change of existing waste practices and the implementation of strategies aiming at waste prevention, separate collection, recycling, composting and waste treatment before final disposal. Improved waste management will generate jobs and income, with recycling generating considerably more jobs than landfilling or incineration.

8.1.4 Key Messages: Nature

Biodiversity is of immense intrinsic value and human well being depends upon it. It is the 'natural capital' that provides a country, its economy and its people with a flow of goods and services that are fundamentally important for prosperity, livelihoods and well-being. The values we receive from our natural capital are immense, and failure to adequately take these values into account in our decisions exposes us to the risk of losing yet more of it.

Biodiversity in the region

- The status of biodiversity is poorly known in much of the region, but it is clear that there is on-going degradation of most ecosystems, and many associated species are declining. Consequently a substantial number of species are threatened nationally, some of which are at risk of global extinction.
- The main threats to biodiversity in the region include: overgrazing, cutting of forest and shrublands for firewood (leading to desertification), fires, expansion of agricultural land and agricultural intensification, population growth and rapid urbanisation (combined with poor planning), wetland drainage, pollution, illegal hunting and overexploitation of some species, especially fish, and the spread of invasive species.
- One of the principal means of protecting biodiversity (and associated natural capital) is through the protection of areas of very high biodiversity that are at risk of degradation. This is recognised by the Convention on Biological Diversity (CBD), which has set a target of achieving at least 17 per cent protected area coverage of terrestrial and inland water bodies, and 10 per cent of marine areas, by 2020. Although it is difficult to obtain consistent and up-to-date data on protected area coverage (due to differing national interpretations of protected area definitions, and on-going protected area expansion), it is clear that the achievement of the CBD target would substantially increase the protection of biodiversity within most countries in the region.
- Only Israel and Algeria currently have protected areas that exceed the CBD coverage target, whilst Egypt is close to the target and aims to reach it by 2017. The achievement of the CBD target would result in significant increases in protected area coverage, and associated biodiversity and ecosystem service benefits, in Jordan, Lebanon, Morocco, the OPT, Syria and Tunisia.

The status of marine protected areas in the region could not be reliably deduced from existing data for this study, but in general marine areas are poorly represented in the protected areas network. It appears that further protection of marine habitats is also required in most countries.

- It must be remembered that protected area coverage is a crude measure of biodiversity conservation effectiveness, as the strength of protection and appropriateness of land and marine management measures within protected areas is of key importance. In this respect it is clear that considerable improvements could be made in the designation of protected areas and in the effectiveness of protected area management in the region.
- There is considerable uncertainty over the potential ecosystem service related benefits of increasing protected area coverage in the region. However, the assessments indicate that the most important benefits of increasing protected area coverage in the region are likely to be related to the protection of carbon reserves, the improvement of raw water resources in terms of quality and quantity (through better protection and management of vegetation in vulnerable catchments), capturing of pollutants from waste water and run-off (e.g. from agricultural land) in catchments of water bodies that are polluted or vulnerable to further pollution and habitat provision for threatened species. Some significant benefits could arise with regard to cultural services (e.g. recreation and tourism), but it is uncertain to what extent protected areas are needed to maintain such services in the region in the short term.

Forests, unsustainable forest management and carbon storage

- Forest cover in the Southern partner countries as a whole is at around 2 per cent of the territory; the highest level is 13 per cent in Lebanon, 11.5 per cent in Morocco, 7 per cent in Israel and 6.5 per cent in Tunisia. Syria has just over 2.5 per cent forest cover. All others have less than 1 per cent forest coverage[52]. Egypt has the lowest percentage coverage at less than 0.1 per cent of territory being covered by forest.
- Net forest coverage has increased over the 20 year period for most of the countries in the region - for example in Israel, Egypt and Tunisia. Only in Algeria does the FAO data used suggest a historical trend of net deforestation, though national data suggest that net deforestation may be less of an issue. There are, however, concerns of deforestation at local levels and associated issues of degradation across the region. Furthermore, a loss of a hectare of old growth forests generally implies a far greater loss of ecosystem services (carbon stored, water retention, storage and purification) and biodiversity than afforestation of new growth achieves – so the actual benefits of avoiding deforestation are more widespread and significant than average net national data would suggest. New growth or regeneration not only does not fully offset losses of old forest, but also in some countries current management practices do not allow natural regeneration, leading to increasing degradation and fragmentation. For instance, the reforestation rate in Morocco is considered below the optimal rate (15 to 20 per cent for maintaining a functioning level of ecosystem services).

[52] The value for the OPT has been estimated at 1.5% but the data appear less robust.

- While the project has focused on ENPI wide comparable data, building on FAO, future research is clearly needed on national and local data at both gross and net forest changes.
- Forests have multiple uses; in Southern partner countries a range have been designated specifically for production (particularly in Algeria, Tunisia and Morocco), for the protection of soil and water (particularly Libya and Jordan, but also Algeria, Egypt and Tunisia and to a less though still significant extent in Lebanon and Israel. A range of forests are also designated for the conservation of biodiversity – up to 18 per cent of forests in Israel and 12 per cent in Algeria and Morocco.
- Carbon storage: forests in the Southern partner countries contain 328 million metric tons of carbon in living forest biomass, equivalent to 1202 million tCO_2. This is, however, an underestimate of the carbon storage in forests given that there are also important quantities in the soil and litter. Note also that the underlying data on carbon content per hectare of forest is still under-researched, and there are high variations across countries - e.g. the highest is in Egypt (near 100 tonnes C/ha for living biomass) and the lowest in Tunisia (around 10 tonnes C/ha for living biomass). This can affect the total values. Similarly the existing data on forest carbon only covers the living biomass and does not include the carbon in the soil and litter. This can be very significant and hence the carbon stored and the subsequent value calculations should be seen as an underestimate.
- Meeting the ENPI wide target of halting deforestation by 2020 will (at a net level and based on historical projections) only be a relevant target for Algeria (halting all deforestation would affect all countries as there is land use change in all countries). Were historical trends as noted in FAO to continue to 2020, there would be a potential to save more than 180,000 hectares of forest in the next decade, corresponding to a net saving of about 11 million tons of CO_2 in living forest biomass. However, past trends do not necessarily well predict future developments and deforestation could be a major issue at the local and even at the national level.
- Value of carbon storage, avoided loss and stock gains: Assuming a value of CO_2 of €17.2 /ton (low) and €32 /ton (high) in 2010, the value of the carbon currently stored by the forests would be estimated to range between €21 to €39 billion (see later point on stock and marginal values and also the BAM). Around two thirds of this amount relates to Morocco's forests, the 5.1 million hectares, store 221 million tonnes of carbon (C), equivalent to 809 million tonnes of CO_2 and with a value range of €14 to €26 billion stock value today. Algeria has the second highest share at around 21 per cent. This is an indication of the value of the carbon stored in the living biomass today.
- By 2020, the stock of carbon in living biomass - assuming projected carbon values of €39/ton (low) and €56/ton (high) – would suggest values of €48 billion to €68.5 billion (stock value). In Algeria, halting forest loss by 2020, would (building on FAO data and projections to 2020) enable between €400 and €600 million of potential carbon losses to be avoided. Other countries can similarly avoid carbon losses and hence avoid emitting CO_2 in halting local deforestation or degradation where realistically possible.
- The benefits of forests as carbon store increases with the continued growth of forests – this has been estimated to lead to a carbon gain of €670 to €970 million for the ENPI

South region from the growth in forests. The standing biomass also gains in value over the period given the expected rise in the 'value' of $C0_2$.

Land degradation – croplands

- The economic contribution of agriculture varies across the Southern partner countries, ranging from less than 3 per cent of GDP in Israel and Jordan to 20 per cent in Syria in 2008. The sector continues, however, to be a major source of employment, ranging from 20 to over 40 per cent in Algeria, Syria, Egypt and Morocco.
- Systematic and nationwide information on land degradation is scarce, but the global GLASOD survey indicates that severely and very severely degraded land ranges between less than 10 per cent of the national land territory in Israel and Egypt to 60-80 per cent in Syria and Tunisia.
- Improving agricultural crop land management and reversing land degradation have many benefits, including increased agricultural crop yields, reduced soil and agro-chemical run-offs, reduced sedimentation of rivers, lakes and reservoirs, reduced water pollution, and can contribute to reduced desertification.
- Improved crop land quality from better land management may provide important benefits in term of increased crop yields, ranging from an estimated nationwide average of 2-3 per cent in Israel to 7-15 per cent in Jordan, Syria and Tunisia.
- The benefits of these yield increases amount to €4.9-8.6 billion (PPP) per year in 2020. This on average is equivalent to 0.36-0.65 per cent in the Southern partner countries, but as high as 0.6-1.0 per cent of GDP in Egypt, Morocco and Tunisia and 1.1-1.5 per cent of GDP in Syria in 2020.

8.1.5 Key Messages: Climate change

Renewable Energy Sources (RES)

- Several countries are experiencing significant growth in CO_2 emissions, due to economic growth and rapid urbanisation. Power generation is primarily fuelled by fossil energy sources, mainly oil but also coal and natural gas, which are often imported. Renewable energy sources (RES) represent only a minor share of the total energy production.
- The total CO_2 emissions from energy consumption in the region amounted to around 475 million tonnes of CO_2 in 2008, or an average of 2.4 tonnes of CO_2/capita. There is a wide range across the countries in the region, with per capital emission from energy use going from 1.3 tonnes of CO_2/capita/year in Morocco to 8.6 tonnes of CO_2/capita/year in Israel, reflecting climate, energy resources and infrastructure, economic activity, and social norms.
- Renewable energy sources (RES) contribution to overall gross final energy consumption is currently just under 2 per cent for ENPI South (excluding OPT (no data) and Libya) – it provided 2.4 million tonnes of oil equivalent (mtoe) of a total of 124 mtoe final energy consumption for the region. The RES share in 2008 ranges from less than 1 per cent in

Algeria to 8 per cent in Israel (mainly passive solar) and nearly 15 per cent in Tunisia (mainly waste-to-energy). The contribution of RES and in particular to electricity generation (at well below 1 per cent) is still far from its technical potential.

- Potential for renewable energies: The increased uptake of renewable energy sources represents a major potential for the region to reduce GHG emissions as well as to address energy security (including reducing dependency from energy imports), cost issues as well as having a potential to create new employment and driver of the economy (also in isolated locations that are not connected to the electricity grid). It should also be taken into account that, while renewables themselves are non-polluting, the structures built to harness them can have positive or negative environmental impacts. It is thus crucial to make sure that possible impacts from RES on the local environment are avoided or mitigated. For example, dams for hydropower (e.g. in Morocco) may affect fish migration, while biomass use can increase deforestation.
- In the Southern partner countries, the amount of gross final energy consumption from RES, if the ENPI RES target were not met, is estimated at around 2.6 mtoe – using a conservative energy conservation baseline (same per capita energy use) and a conservative RES share (building on existing RES share). If the 20 per cent ENPI wide target were met the RES contribution would be 31 mtoe, around 25 mtoe more than in the baseline scenario which would displace other fuel use at the same relative share as today's fuel mix..
- Avoided CO_2 emissions: An increase of the RES share of gross energy consumption from current levels to 20 per cent is estimated to reduce CO_2 emissions by about 95 million tonnes CO_2 by 2020.
- Value of CO_2 savings: Assuming a CO_2 value ranging from €39 and €56 per tonne in 2020, the reduced emission from CO_2 estimated above will represent a saving of between €3.5 and €5.25 billion per year in 2020. For the purpose of comparing the results to current money values, if the RES target were to be met today the benefits from reduced emissions would be between €1.5 and €2.9 billion per year given lower carbon prices in 2010 (€17 and €32 per tonne).

Climate impacts and adaptation

- A significant and accelerating trend in mean temperature increase has been identified in the region. Over this century rainfall patterns are likely to change, resulting in dryer summers and winters, but more extreme rainfall events resulting in increased flood risks.
- These trends in climate are projected to result in a wide variety of impacts across sectors in the region and are judged to be overwhelmingly negative. Whilst agricultural crops may benefit marginally from enhanced CO_2 fertilisation effects, these are likely to be outweighed by water constraints and flooding that both reduce crop productivity.
- The most common impacts identified across the region are: i) constraints on water resources arising from changing rainfall patterns combined with higher rates of evapo-transpiration, particularly on agriculture, exacerbation of desertification, and service

access for urban populations; ii), coastal erosion and inundation; and iii) the impacts on infrastructure and other resources as a result of river flooding.

- The potential impacts of climate change on ecosystems and biodiversity, human health and forestry are also recognised as being significant (some of which are assessed under other parameters studies in this report, such as biodiversity and water scarcity).
- The recognition that climate change is occurring and is likely to continue has led to a wide variety of adaptation measures being considered to combat this range of potential climate change impacts. Emphasis is being put on adapting to projected water resource constraints in order to provide security of supply to domestic and industrial users as well as agricultural producers.
- The need for such adaptation is acute given the current water stress across this region. The benefits of investment in water supply technologies combined with demand management strategies are particularly important for agricultural producers and urban consumers and are critical to economic development and social stability.

8.2 Recommendations

The insights from the analysis in the country studies underline that the environment merits being given greater attention in policy making, implementation, financing and enforcement. This offers benefits in terms of cost savings, potential contributions to a range of important other policy objectives, to improved security (food, water, energy and climate), and to improved quality of life of citizens.

Strengthening national environmental policies/targets and obtaining due support for their implementation, should result in progress in each of the air, water, waste, nature and climate change domains. Such progress will be a valuable step in the transition to a green, equitable economy.

In the current climate of change in the ENPI South region, environmental technologies can be a core driver of green, equitable growth and of job creation. Renewable energies are a major potential for the region, developing not only its own capacities but also exporting its capacities to Europe. Improving infrastructures is an opportunity to benefit many millions across the region in access to quality services, for example the areas of water or waste management. Safeguarding productivity by avoiding the degradation of natural capital also has the potential to help with poverty and rural urban migration issues.

The assessments done under this project, should be seen as a first illustrative estimate and not as a final definitive analysis. For national policy reflections own analysis could usefully be carried out to complement the indicative values calculated under this project; having a core set of country specific assumptions with a range of scenarios and sensitivities would offer additional nuance and robustness. National/local policy makers and stakeholders could therefore adapt the analysis framework used for the country benefit assessment reports and tailor the methodologies that have been developed and applied under this project. All methodologies are fully documented in the Benefit Assessment Manual (BAM) for Policymakers which has been developed under this project.

The results of this project could be taken further by the countries and used for conducting their own national benefit assessment studies, in order to support good governance and facilitate identification of priority areas for progress. A culture of benefit assessments and taking account of the benefits of enhanced environmental protection in decision making should be encouraged.

Investment in measurement and data is key for management. There is a need for good data, indicators, and also a move towards (environmental) capital accounts and satellite accounts to help ensure that policy makers have due information at their disposal.

Finally, it should be kept in mind that the faster environmental policies are implemented, the earlier the benefits will be obtained and the longer these will be enjoyed. Acting quickly will also help avoid costs (of inaction) that can be significantly more costly than late action – so there is a double benefit of early action.

There is a major potential for a green new deal in the ENPI South countries focusing on a range of environmental improvements, which will benefit not just the environment (water and air quality, conservation status, forest health and soil quality), but also benefit health and wellbeing, livelihoods (jobs and community viability), economics and financing (avoiding costs) as well as supporting confidence in government.

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