***Country-led environmental and climate change mainstreaming (specialist course)***

**Handout for participants**

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**MODULE 2**

**Understanding environment-climate change -development linkages**

**MODULE 2 – Understanding environment-climate change–development linkages**

**Topics covered by the module:**

* Environment and climate change
* Environment, climate change and development linkages
* Moving towards green, low-carbon, climate-resilient development

**Key tool:**

* Conceptual framework of interactions between ecosystem services, human well-being and poverty reduction, and drivers of change(Millennium Ecosystem Assessment 2005).

**Key concepts and messages:**

*Environment and climate change*

1. Human activities and the *environment* (in the wider sense, including climate and natural resources) are in constant interaction. On the one hand, the environment is a source of opportunities, risks and constraints for human activities; *adaptation* addresses these opportunities, risks and constraints. On the other hand, human activities exercise pressure and generate impacts on the natural environment; *mitigation* addresses these pressures and impacts, in particular for minimising negative impacts.

1. *Adaptation to climate change* involves adopting measures to protect natural and human systems against the actual and expected harmful effects of climate change, to exploit any opportunities it may generate, and to ensure the sustainability of investment and development interventions in more difficult climatic conditions; it aims to reduce *sensitivity* and vulnerability to the effects of climate change (Klein et al 2005, IPCC 2007a, EC 2009b, World Bank 2010a).
2. *Climate change mitigation* involves reducing greenhouse gas (GHG) emissions and/or enhancing the capacity of ‘sinks’ for GHGs (i.e. processes and mechanisms that remove greenhouse gases or their precursors from the atmosphere), for the ultimate purpose of stabilising their concentration in the atmosphere; it aims to reduce global *exposure* to the effects of climate change (IPCC 2007d, EC 2009b).
3. *Vulnerability* is the extent to which a system, individual or group of people is susceptible to, and unable to cope with, adverse effects of any kind, in this context of pressure on the environment and natural resources and climate change. Vulnerability depends on:
   * *exposure*to hazards (i.e. the extent to which a system, individual or group is exposed to the physical manifestations of environmental degradation and/or climate change);
   * *sensitivity* to the effects (i.e. the degree to which a system, individual or group is affected, either positively or negatively, directly or indirectly);
   * and adaptive capacity (Brooks 2003, IPCC 2007c, EC 2009b, OECD 2009a).

Vulnerability is commonly applied in the context of climate change, where it is particularly useful to identify the most effective policy responses, as well as to address the social dimensions of climate change in an explicit manner.

1. *Adaptive capacity* is the extent to which a system, individual or group has the capabilities, and/or has access to the information, resources and institutions, required to cope with existing or anticipated external stresses – and in this specific context, to adapt to climate change, notably through the adoption of risk prevention and management measures (Brooks 2003, IPCC 2007c, EC 2009b, OECD 2009a) as well as to the degradation of natural resources. In the context of climate change it has also been defined as ‘the property of a system to adjust its characteristics or behaviour, in order to expand its coping range under existing climate variability, or future climate conditions’ (Brooks & Adger 2004: 168). Note that adaptive capacity can be ‘generic’ (i.e. supportive of a positive reaction to stresses of various types), or specific to climate change-related stresses (Burton & van Aalst 2004). Increased adaptive capacity leads to improved *resilience*, i.e. the ability of a system, individual or group to absorb disturbances, and adapt to stress and change (IPCC 2007c); it determines the ability to access and successfully implement adaptation options (Klein et al 2005).
2. Adaptive capacity (and therefore also vulnerability) is strongly influenced by *factors* such as:

* wealth, age, gender, social group;
* education and skills;
* access to information and technology;
* ‘built’ and ‘green’ infrastructure[[1]](#footnote-1);
* institutions and social organisation;
* cultural norms;
* equity and (in)equality;
* the ‘development level’ in general (Brooks & Adger 2004, IPCC 2007c, EC 2009a, OECD 2009a).

1. *Maladaptation* is an inadequate response to climate change, by which ‘business-as-usual’ development interventions that overlook the implications of climate change inadvertently result in increased vulnerability (e.g. building new infrastructure and settlements in flood-prone areas). The term also designates an inadequate adaptation response, which fails to reduce vulnerability to climate change and instead ends up increasing it, displacing it or reducing the future potential for adaptation. For example, maladaptation may result from developing oversized irrigation systems in areas likely to suffer from increasing water scarcity; or building infrastructure such as sea walls that accelerate coastal erosion elsewhere along the coast and, by providing a false sense of security, end up encouraging development in high-risk areas (Burton & van Aalst 2004, EEA 2007, EC 2009b, OECD 2009a, Olhoff & Schaer 2010, World Bank 2010a). Besides disregard for the potential impacts of climate change, one of the factors that may give rise to maladaptation is uncertainty; and ‘adaptation which can be successful at a specific temporal or spatial scale can become maladaptation at a different spatial and temporal scope’ (EEA 2007: 21).
2. *Sustainable development* is a concept that became more widely known and accepted through the publication of the Brundtland Report “Our Common Future” in 1986. In part the concept of sustainable development has been widely accepted because it has been subject to multiple interpretations. Nowadays it is generally accepted that it entails recognising that development has three main components: the economy, the social dimension and the environment; and that all three dimensions are equally important. Nevertheless in practice economic development tends to be prioritised in detriment of the social dimension and, especially, the environment. The three dimensions are nevertheless very closely intertwined, so offsets in one dimension can also adversely affect the other two.
3. Climate change can have biophysical impacts as well as socio-economic impacts.
4. The *biophysical impacts* of climate change, which may vary significantly with location, include:

* changes in average and/or extreme temperature and rainfall patterns, shifts in seasons;
* increased frequency and/or severity of extreme weather events;
* raised sea levels, increased coastal and river bank erosion;
* acceleration in desertification and soil erosion processes;
* decrease in the availability and quality of water, changes in the levels of groundwater, surface water drainage patterns and permafrost;
* loss of habitats and changes in ecosystems, biodiversity loss;
* increased frequency and/or severity of disease and pest outbreaks;
* changes in atmospheric pollution patterns (EC 2009a).

1. These biophysical effects may in turn lead to *socio-economic impacts*, such as:

* damage to or destruction of infrastructure;
* reduction in the availability of energy (hydropower);
* economic disruption, loss of livelihoods and social disruption;
* reduced food security, increased malnutrition;
* increased mortality and morbidity;
* increased probability and intensity of conflicts;
* population displacement and human migrations (EC 2009a).

1. **Table 1.1** provides illustrations of some of these linkages between biophysical and socio-economic impacts.

**Table 1.1 – Examples of climate change impacts**

| **PHENOMENON AND DIRECTION OF TREND** | **LIKELIHOOD OF FUTURE TRENDS BASED ON SRES SCENARIOS** | **EXAMPLES OF MAJOR PROJECTED IMPACTS BY SECTOR** | | | |
| --- | --- | --- | --- | --- | --- |
|  |  | **AGRICULTURE, FORESTRY AND ECOSYSTEMS** | **WATER RESOURCES** | **HUMAN HEALTH** | **INDUSTRY, SETTLEMENT AND SOCIETY** |
| Over most land areas, fewer cold days and nights, warmer and more frequent hot days and nights | Virtually certain | Increased yields in colder environments; decreased yields in warmer environments; increased insect outbreaks | Effects on water resources relying on snow melt; effects on some water supply | Reduced human mortality from decreased cold exposure; increased mortality and illness due to malaria | Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice; effects on winter tourism |
| Warm spells/heat waves. Frequency increases over  most areas | Very likely | Reduced yields in warmer regions due to heat stress; wild fire danger increase | Increased water demands; water quality problems, e.g. algal blooms | Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially-isolated | Reduction in quality of life for people in warm areas without appropriate housing; impacts on elderly, very young and poor |
| Heavy precipitation events. Frequency increases over  most areas | Very likely | Damage to crops; soil erosion, inability to cultivate land due to water logging of soils | Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved | Increased risk of deaths, injuries, infectious, respiratory and skin disease | Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property |
| Area affected by drought increases | Likely | Land degradation; lower yields, crop damage and failure; increased livestock deaths; increased risk of wild fire | More widespread stress on water supply or availability | Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases | Water shortages for settlements, industry, and societies; reduced hydropower generation potentials; potential for population migration |
| Increased incidence of extreme high  sea level (excludes tsunamis) | Likely | Salinization of irrigation water, estuaries and freshwater systems | Decreased freshwater availability due to saltwater intrusion | Increased risk of deaths and injuries by drowning in floods; migration-related health effects | Costs of coastal protection versus costs of land-use relocation; potential for movements of people and infrastructure |
| Information for this exhibit was taken from “Climate Change Impacts, Adaptation and Vulnerability - Summary for Policy Makers of the Working Group II (World),” IPCC, http://www.ipcc-wg2.org/. | | | | | |

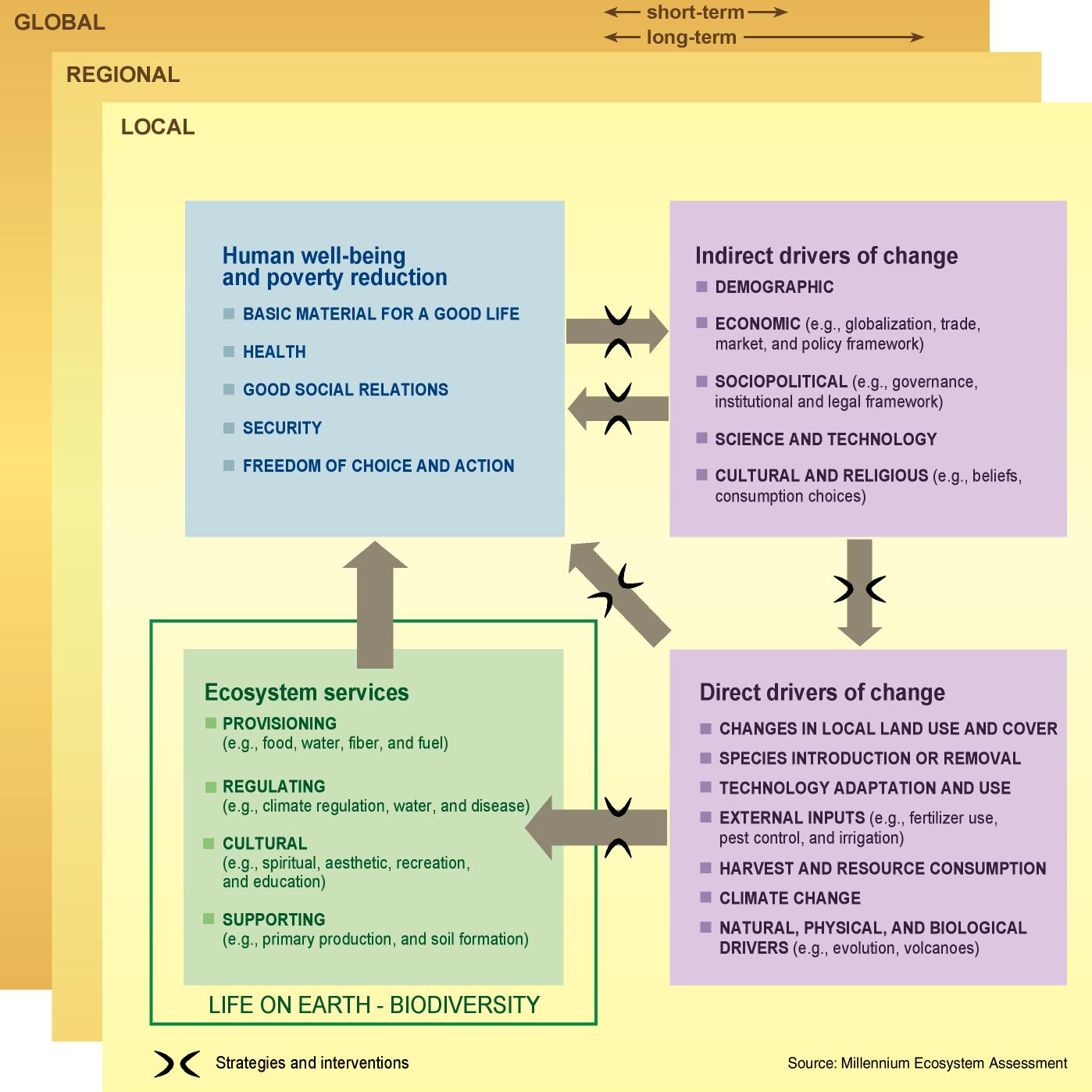
Source: USAID (2007) *Adapting to Climate Variability and Change: A guidance manual for development planning*. United States Agency for International Development, Washington, DC. Exhibit 3, p. 4 – based on IPCC report as quoted.

1. *Vulnerability factors* influence the way in which the biophysical effects and impacts of climate change generate socio-economic impacts. Poor countries, and the poor and socially vulnerable within each country, are disproportionately vulnerable to the effects of climate change as they cumulate vulnerability factors, including: dependence on natural resources for livelihoods; lack of financial resources; poor health and education levels; poor or no access to infrastructure, essential services and social safety nets; gender-based inequalities; and exposure to degraded ecosystems, social inequities, poor governance practices and weak institutions (World Bank 2010a, World Bank 2010g).

*Links between environment, climate change and development*

1. **Figure 1.1**, from the Millennium Ecosystem Assessment (2005), provides a good illustration of the linkages between economic activities, environmental change, climate change, human well-being and poverty reduction. **Annex 1.1** lists a number of guiding questions for assessing environment–development–poverty linkages, and **Annex 1.2** lists a number of guiding questions for assessing climate–development–poverty linkages.
2. Economic activities, one of the indirect drivers of ecosystem changes, are also a key cause of climate change, which is in turn a direct driver of changes in ecosystem services. Climate change affects human well-being and the outcome of poverty reduction efforts, directly and through its effects on ecosystem services. *Climate change is both a development issue and an environmental issue*.

**Figure 1.1 – Conceptual framework of interactions between ecosystem services,   
human well-being and poverty reduction, and drivers of change**



Source: Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-being: Synthesis*.   
Figure B, p. 7.

1. The wide range of biophysical effects and socio-economic impacts of climate change, if not addressed, threaten all three pillars (economic, social and environmental) of *sustainable development* (EC 2009b). Both adaptation to climate change and climate change mitigation can support more sustainable development – while the pursuit of sustainable development can enhance society’s response capacity in terms of both adaptation and mitigation (IPCC 2007c).
2. Climate is a critical aspect of the environment. *Climate change should be addressed with other environmental issues*, for two main reasons:
   * It exacerbates a wide range of existing environmental trends and problems (e.g. desertification, freshwater scarcity, loss of biodiversity, air pollution).
   * The way we manage environment-related issues (e.g. waste management, soil management, land use planning and management) has an impact on climate change.
3. The environment is closely related to the *Millennium Development Goals (MDGs)*, and environmental degradation can threaten their achievement. In a similar fashion climate change may also threaten achievement of MDGs(OECD 2009a). **Table 1.2** provides illustrations of the relationships between environment, climate change and MDGs. Again, both adaptation and mitigation efforts can support the achievement of the MDGs.

**Table 1.2 – Relationship between the environment, climate change and the Millennium Development Goals**

| **MILLENNIUM DEVELOPMENT GOAL** | **EXAMPLES OF LINKS WITH THE ENVIRONMENT** | **EXAMPLES OF LINKS WITH CLIMATE CHANGE** |
| --- | --- | --- |
| **Eradicate extreme poverty and hunger (Goal 1)** | Environmental degradation affects food production, e.g. through land degradation, soil erosion, soil salinization, depletion of freshwater sources.  Loss of biodiversity affects access of sources of animal protein as well as medicinal plants.  Environmental degradation affects health of the population, e.g. through indoor air pollution (mainly in rural areas), atmospheric pollution (urban areas), water pollution. | Climate change is projected to reduce the assets and livelihoods of many poor people, for example health, access to water, homes, and infrastructure.  Climate change is expected to alter the path and rate of economic growth because of changes in natural systems and resources, infrastructure, and labour productivity. A reduction in economic growth directly affects poverty through reduced income opportunities.  Climate change is projected to alter regional food security. In particular in Africa, food security is expected to worsen. Adverse impacts on food security could be seen in Latin America, as well as in South and South-East Asia. |
| **Achieving universal primary education**  **(Goal 2)** | Deforestation and reduced freshwater availability may require children spending more time fetching these resources instead of going to school.  Environmental diseases affect school attendance and capacity to concentrate. They also affect attendance of teachers.  Primary education offers opportunities for education on environmental protection. | Extreme weather events can destroy educational infrastructure and access roads.  Climate change can increase the incidence of vector-borne diseases, affecting school attendance by children and teachers.  Primary education offers opportunities for education on climate change adaptation and disaster risk reduction. |
| **Promote gender equality and empower women (Goal 3)** | In many societies key environmental resources are harvested by women, especially water and firewood. Degradation and scarcity of these resources will firstly affect women.  Women generally have a lower adaptation capacity, e.g. in getting access to agricultural credit and insurance. In the context of degraded natural resources, women are thus more adversely affected. | In the developing world in particular, women are disproportionately involved in natural resource-dependent activities, such as agriculture, which are particularly vulnerable to climate change.  Women’s traditional roles as primary users and managers of natural resources, primary caregivers and labourers engaged in unpaid labour (*i.e.* subsistence farming) mean they are involved in and dependent on livelihood and resources that are put most at risk by climate change. |

| **MILLENNIUM DEVELOPMENT GOAL** | **EXAMPLES OF LINKS WITH THE ENVIRONMENT** | **EXAMPLES OF LINKS WITH CLIMATE CHANGE** |
| --- | --- | --- |
| **Health-related goals:**  **Combat major diseases (Goal 6)**  **Reduce child mortality (Goal 4)**  **Improve maternal health (Goal 5)** | The global burden of disease is highly related to environmental factors. Addressing main causes of morbidity and mortality in developing countries requires addressing environmental factors such as: water quality, atmospheric air quality, indoor air quality, exposure to toxic substances (especially pesticides).  Morbidity and mortality in developing countries is also closely related to bad nutrition, which in turn is often associated to low agricultural productivity due to land degradation. | Direct effects of climate change include increases in heat-related mortality and illnesses associated with heat waves (although fewer winter cold-related deaths may occur in some regions).  Climate change may increase the prevalence of some vector-borne diseases (for example malaria and dengue fever), and vulnerability to water, food, or contagious diseases (for example cholera and dysentery).  Children and pregnant women are particularly susceptible to vector and water­borne diseases. Anaemia – resulting from malaria – is responsible for a quarter of maternal mortality.  Climate change will likely result in declining quantity and quality of drinking water in many locations, which is a prerequisite for good health, and exacerbate malnutrition – an important source of ill health among children – by reducing natural resource productivity and threatening food security, particularly in sub-Saharan Africa, but also in many other low latitude areas. |
| **Ensure environmental sustainability (Goal 7)** |  | Climate change is likely to alter the quality and productivity of natural resources and ecosystems, some of which may be irreversibly damaged, and these changes may also decrease biological diversity and compound existing environmental degradation. |
| **Global partnerships**  **(Goal 8)** | Environmental degradation often has a transboundary and global dimension, e.g. in relationship to water basins, biological corridors, trade in chemical substances and hazardous wastes. | Climate change is a global issue and response requires global co-operation, especially to help developing countries adapt to the adverse impacts of climate change. |
|  | Multi-Agency Report (2003), “Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation”, report by the African Development Bank, Asian Development Bank, UK Department for International Development, Federal Ministry for Economic Co-operation and Development (Germany), Ministry of Foreign Affairs Development Co-operation (Netherlands), OECD, United Nations Development Programme, United Nations Environment Programme and World Bank; Sperling, F. (ed.), Washington.  IPCC (2007), “Climate Change 2007: Impacts, Adaptation and Vulnerability”, Working Group II Contribution to the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, “Chapter 17: Assessment of Adaptation Practices, Options, Constraints and Capacity”, Cambridge University Press, Cambridge, pp. 717-743.  WEDO (Women’s Environment and Development Organization) (2008), *Gender, Climate Change and Human Security*, policy report developed for the Greece Government Chairmanship of the Human Security Network, New York/Athens. | |

Sources for information on climate change: OECD (2009a) *Integrating Climate Change Adaptation into Development Co-operation: Policy guidance*. Table 1.1, p. 29. Information of environment taken from UNDP-UNEP PEI (2009), p. 10.

1. All sectors of development have a link with the environment, be it because activities in the sector produce adverse environmental impacts and/or the degradation of the environment affects sector performance. **Table 1.3** provides an overview of some of these interactions.

**Table 1.3 – Examples of links between sectors of development and the environment**

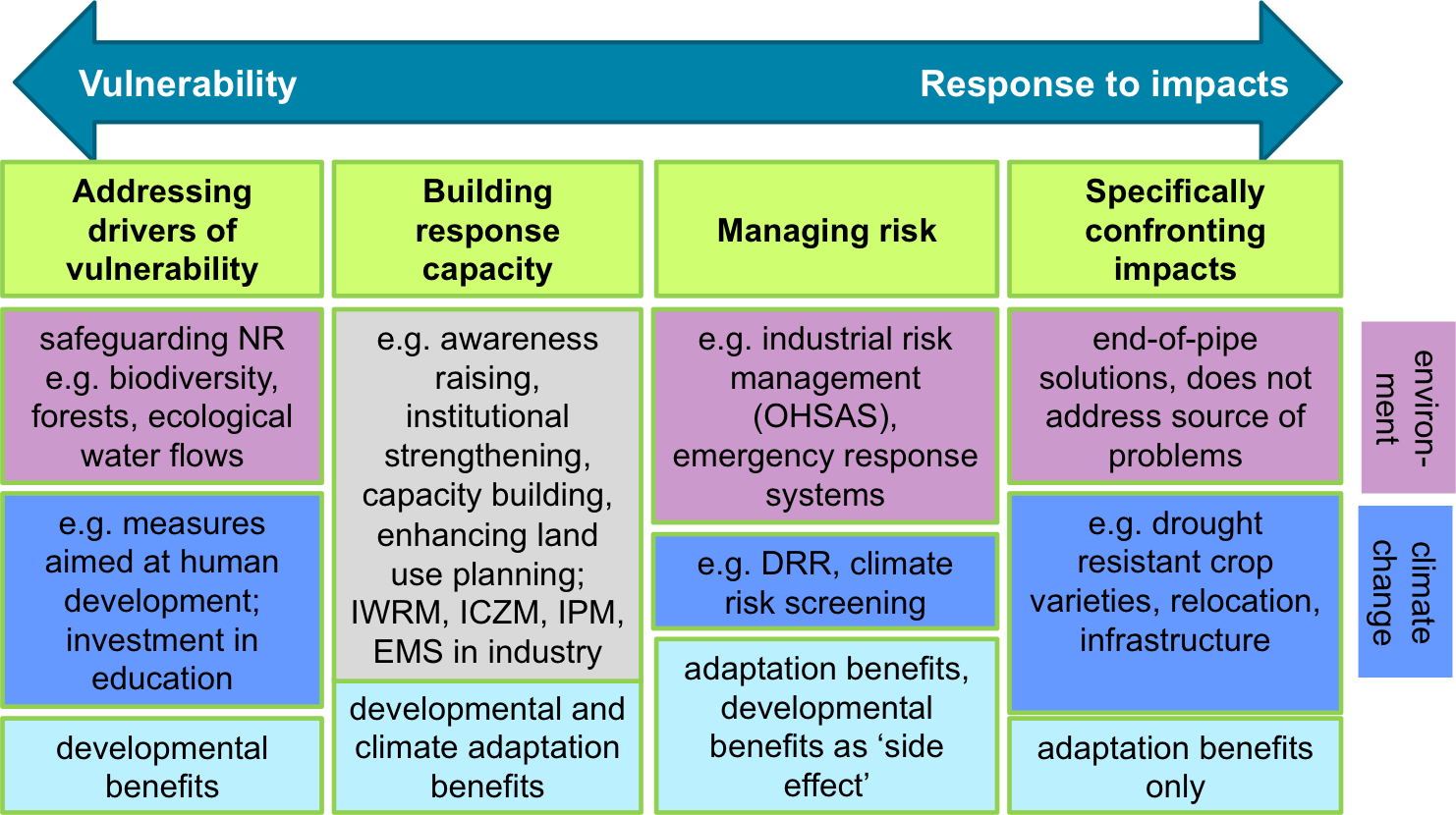
|  |  |
| --- | --- |
| **Environmental pressures from sector activity** | **Environmental factors influencing the sector** |
| ***Good Governance and rule of law*** | |
| Normally actions in this sector would have (mainly indirect) positive effects on the environment. However poor governance (e.g. poor enforcement capacities, corruption, limited access to justice) may have important indirect consequences on human activities affecting the environment, for example:   * Increased pressure on natural resources (including mining, land clearing, illegal logging and poaching) and associated impacts (e.g. pollution, soil erosion, loss of biodiversity, resource depletion, waste). * Increased energy consumption and GHG emissions. * Land use changes due to, e.g. illegal logging/deforestation, irregular settlements/urbanisation. | * Environmental factors affecting migration, health, labour productivity, gender division of labour (e.g. depletion of natural resources generating competition for their access, water and atmospheric pollution affecting health and labour productivity, water scarcity obliging women to fetch water from distant places). * Natural disasters, effects of increasing climate variability and climate change, environmental damage causing economic costs and affecting human life. |
| ***Land use planning, Infrastructure and transport*** | |
| * Direct impacts of infrastructure, such as soil erosion, changes in water regime, pollution, ecosystem fragmentation, increased access to vulnerable resources (e.g. forest roads). * Impacts of traffic and transport, such as energy consumption, polluting atmospheric emissions, noise, vibration, accidents, accidental pollution. * Impacts of physical flows, such as transfers (e.g. loss of natural resources, transfer of soil nutrients, accumulation of waste), introduction of alien species. * Indirect impacts through social and economic changes, including concentration of economic activities (e.g. harbours) and impacts of induced economic activities (e.g. mining, industry). * Changes in land use, urbanisation * Changes in water regime, floods resulting from changes in land use | * Variability in water level and streams affecting river transport * Eutrophication of lakes affecting hydroelectric power potential * Soil erosion, leading to accelerated sedimentation of dams and thus reduction of their life-span * Indirect impacts from land use patterns and distribution of natural resources (e.g. loss of land for agriculture through urbanisation) * Floods, erosion and soil instability affecting road viability * Natural disasters, effects of increasing climate variability and climate change, environmental damage affecting infrastructure viability |
| ***Water and Energy*** | |
| * Depletion of water resources * Water pollution; eutrophication, salinization * Wetland drainage * Changes in surface water regime and in groundwater resources * Biodiversity losses in (and around) wetlands - direct and indirect impacts from dam building, including transboundary impacts * Pollution from oil, gas and coal industry * GHG emissions; air pollution (indoor and ambient) and acid rain * Deforestation resulting from excessive consumption of firewood | * Depletion of water or energy resources, e.g. fuelwood, freshwater, dam siltation resulting from soil erosion * Changes in water quality and availability including from climate variability and climate change * Flooding affecting (notably) clean water supply * Climate variability affecting energy services and infrastructure |
| ***Human development (including health and education)*** | |
| * Indirect impacts due to population growth, migration, environmental education, modified activities and consumption or practices (e.g. construction and operation of schools and hospitals) * Contamination through vector control (pesticides) * Increased resistance of vectors and pathogenic organisms * Pollution (chemical, biological) and hazardous waste (including bio-medical waste) * Overexploitation of biodiversity resources for medicinal purposes | * Environmental quality in human settlements and work place: waste management (including domestic waste) and sanitation; noise; clean water, air quality (ambient and indoor); exposure to chemicals and heavy metals; occupational health hazards; overcrowding * Vector and water-borne diseases * Environmental causes of malnutrition (e.g. poor soils, overfishing, overhunting, poor crop yields) * Biodiversity resources used as medicines * Environmental constraints on school attendance (e.g. time spent by girls in wood and water collection) |
| ***Rural development, agriculture, food security*** | |
| * Contamination by fertilisers/pesticides * Water pollution, eutrophication, decreased water availability for other uses * Water-borne diseases * Soil degradation, desertification, erosion, acidification, salinization, siltation of reservoirs * Deforestation, re-forestation, land clearance for agriculture and/or cattle breeding, excessive timber or fuelwood harvesting * Habitat reduction and/or fragmentation * Overgrazing * Decreases in fish stocks, wildlife, non-timber forest products, timber * Biodiversity decline, introduction of alien species or genetically modified organisms (GMOs) * Increased pest resistance | * Availability and quality of water resources * Forest area and production * Rangeland * Fires * Fish stocks * Hydrological changes * Biodiversity, agro-biodiversity, pests, weeds * Land degradation and erosion, desertification * Pollution |
| ***Environment and management of natural resources*** | |
| While pursuing an environmental objective, side effects should always be taken into account. For example:   * Resources use displacement the establishment of protected areas may increase the pressures on other resources * Pollution displacement: waste disposal may pollute the water table; hospital incinerators produce dioxins * Competing uses: managing a resource for a particular purpose (e.g. water for human and agricultural uses) may compete with other uses (e.g. wetlands and biodiversity conservation) | By definition, environmental problems are addressed, but external environmental factors should be taken into account: e.g. impacts from other sectors, transboundary impacts, climate change.   * Deforestation, reforestation, land clearance for agriculture * Pollution * Fires * Overgrazing, overfishing, overhunting, excessive timber or wood harvesting * Biodiversity decline, introduction of alien species or GMOs |

Source: adapted from EC (2009b) *Guidelines on the Integration of Environment and Climate Change in Development Cooperation. European Commission, Brussels,* p. 64-75.

1. Especially in the context of climate change many *adaptation measures overlap with development measures* – and climate policy overlaps with development policy, even if their time horizons differ (Burton & van Aalst 2004, Klein et al 2005, OECD 2009a). Development, notably through achieving the MDGs, is critical to reducing vulnerability to climate change (Fankhauser & Schmidt-Traub 2010, World Bank 2010c, World Bank 2010g) – and the factors that constrain or facilitate adaptation are often the same factors that constrain or facilitate development. Most development processes can bridge the ‘adaptation deficit’, i.e. the failures in managing and adapting to current climate variability and risks[[2]](#footnote-2), thereby preparing the ground for adaptation to climate change. However, ‘development-as-usual’ is not always conducive to adaptation: the need for flexibility (i.e. possibility of adjustments to evolving conditions) and for avoiding anything that might increase future vulnerability must be kept in mind (Burton & van Aalst 2004, Sperling et al 2008).
2. There is a *continuum of issues* between addressing underlying causes of vulnerability and responding to impacts(see **Figure 1.3**):

* Some measures address the drivers of vulnerability, and deliver primarily developmental benefits (e.g. any measures aimed at reducing poverty and enhancing human development). In the case of environment, these include measures oriented towards safeguarding the natural resource base, guaranteeing a critical mass that will keep ecosystems functioning and resilient (e.g. forest cover, biodiversity, ecological water flows).
* Some measures help build the response capacity, producing benefits in terms of adaptation and overall development (e.g. awareness raising on environment- and climate–development linkages, institutional building, development of weather and climate monitoring systems, improvements in natural resource management and land use planning practices, integrated water resources management, integrated coastal zone management, environmental management systems).
* Some measures, focused on managing environmental and climate risks, involve developmental benefits as a positive ‘side effect’ (e.g. climate risk screening and assessment, environmental screening and assessment, industrial risk management, climate proofing of projects and infrastructure resulting in improved resilience to current climate conditions, project design to minimise environmental impacts and address opportunities for increased environmental protection);
* Some measures, focused quasi exclusively on confronting very specific environmental and climate change impacts, deliver adaptation benefits only (e.g. relocation in view of expected sea level rise, building of dikes, end-of-pipe pollution prevention) (adapted from McGray et al 2007, OECD 2009a, Olhoff & Schaer 2010).

**Figure 1.3 – Continuum of issues**



Inspired and adapted from: McGray et al (2007), OECD (2009a), Olhoff & Schaer (2010).

1. Other *typologies of adaptation measures* exist. The UNFCCC, for instance, distinguishes measures that foster behavioural change, technological and engineering solutions, risk management and vulnerability reduction strategies, research, and capacity building. **Table 1.4**. gives examples of adaptation options based on this classification. Note that these are examples only, not blueprints or pre-defined measures to be integrated in policies and strategies: relevant adaptation measures are very much context-specific and must result from the process of mainstreaming climate change into policies and development plans.

**Table 1.4 – Examples of adaptation measures for sectors most likely to be affected by climate change**

|  | **Fostering behavioural change** | **Technological and engineering solutions** | **Risk management and vulnerability reduction strategies** | **Research** | **Capacity building** |
| --- | --- | --- | --- | --- | --- |
| **Fisheries** | Diversifying sources of income | Downscaling fleet size and fishing effort | Improving mapping and monitoring of fish stocks; adopt ecosystem based approach to fisheries management | Stepping up research on sustainable aquaculture | Increase knowledge of climate change impacts at local level, information dissemination, awareness raising, sharing of best practices, and integration of climate change in planning and decision-making |
| **Coastal zones and marine ecosystems** | Promoting settlements and economic activities in less exposed areas | Building dykes, sea defences and barriers | Early warning systems; coastal afforestation, restoration of mangroves | Establishing baselines of mangroves status and trends, using standardized methods, in order to better understand of sea rising effect on mangroves and reefs |
| **Disaster risk reduction, disaster management** | Awareness raising on how to respond to warning signals, evacuation,… | Construction of shelters | Early warning systems | Improved monitoring and weather forecasts |
| **Health** | Prevention against malaria in newly exposed population | Improving the protection of health infrastructure against extreme weather events | Information systems on climate change related disasters; promotion of healthy environment to reduce breeding grounds for vectors | Strengthening and developing long-range epidemic forecasting systems |
| **Infrastructure** | Raising the awareness of infrastructure managers, both public and private, about climate-related risks and adaptation options | Enhancing resilience in urban, rural and coastal infrastructure (flood protection dykes, dams, small-scale hydraulic infrastructure) | Adopting appropriate engineering standards and building norms, making new infrastructure more resilient to adverse weather conditions and natural disasters | Monitoring trends in migrations and population resettlements, so as to anticipate future needs at the time of planning investments in infrastructure |
| **Water supply and sanitation** | Rainwater harvesting, promoting of water saving techniques | Adopting new technology for safe water in coastal communities to combat salinity due to sea level rise | Protection of groundwater recharge areas (e.g. by not multiplying them and by promoting the kind of vegetation that can maximise water retention and infiltration) | Improving storage capacity by constructing reservoirs at community level |
| **Agriculture[[3]](#footnote-3)** | Promoting water conservation or soil conservation practices | New irrigation technologies | Improving the use of weather forecasts for farmers; insurance to cope with climate risks; creating or strengthening national centres for the conservation and use of diversity of in food plant species | Research on drought, flood and salinity-tolerant varieties of crops |
| **Energy production and use** | Promoting the use of improved stoves, energy conservation and renewable energies | Promoting the use of improved stoves, renewable energies. Introducing new technologies for the use of firewood and for making charcoal | Promoting better use of weather information and forecasts, as well as climate change related disasters; sustainable forest management and biomass production / use | Supporting R&D for low-carbon, sustainable energy technologies |

Source: EC (2009b) *Guidelines on the Integration of Environment and Climate Change in Development Cooperation.   
European Commission, Brussels,* p. 124.

*Green, low-carbon and climate-resilient development*

1. *Green growth* can be defined as ‘a way to pursue economic growth and development, while preventing environmental degradation, biodiversity loss and unsustainable natural resource use’ (OECD 2010b). It provides a way of rethinking the traditional trade-offs between economic development/improved living standards and environmental sustainability, with the perspective of promoting and accelerating sustainable growth. Green growthis relevant to developed and developing countries alike and should be part of the mainstreaming process. It entails:

* the use of a mix of policy instruments to create adequate incentives and disincentives (e.g. regulations and standards, market-based incentives such as tradable permits or payment for environmental services, taxes and subsidies, information-based instruments);
* long-term, stable support for research and development (R&D) and innovation;
* support for the diffusion of clean technologies and related knowledge – and the removal of barriers to clean technology adoption (e.g. trade barriers, regulatory barriers, skills barriers, market failure barriers, environmentally harmful subsidies, policy inconsistencies);
* support for technology transfers (e.g. financing mechanisms for global public goods, joint R&D initiatives);
* the management of the negative employment and distribution effects of the transition to a greener economy, which may require significant re-allocations of capital and labour;
* and the development of new performance assessment frameworks (PAFs), with indicators related to the environmental efficiency of production and consumption, stocks of natural assets, environmental quality and quality of life, and the effectiveness of green growth policy responses and instruments (Dervis et al 2009, OECD 2010b).

1. *Climate-resilient development* requires addressing climate vulnerability, risks and impacts in development planning and budgeting and in the implementation and monitoring of developments strategies, programmes and projects. It rests on the implementation of development activities aimed at addressing vulnerability factors, and of climate risk management and specific adaptation measures focused on the biophysical and socio-economic impacts of climate change. Capacity building underpins all types of measures. Climate-resilient development ‘implies that adaptation to climate change should not be seen as a separate process, but a continuous and integrated one that addresses present and future climate risks’ (Sperling et al 2008: 6) and that adaptation and development should be implemented in a fully integrated manner (Fankhauser & Schmidt-Traub 2010). The ultimate goal is to ensure that the chosen development path adequately addresses both current and future vulnerability, risks and impacts.
2. The concept of *resilience can also be used in reference to the environment* and sets the requirement to look for thresholds that should not be exceeded, such as:

* ecological water flows in river systems;
* quality standards (e.g. air, water, atmospheric emissions, water discharges, construction);
* minimum forested area and protection of mangrove forests;
* continuity of critical biological corridors;
* protection and maintenance of biodiversity and ecosystems.

1. Resilience building requires actions on the social sphere and the environmental sphere; a decrease in vulnerability (e.g. by increasing adaptive capacity, reducing sensitivity and reducing exposure to adverse effects) leads to an increase in resilience of humans and ecosystems.
2. *Low-carbon development* requires addressing sources of GHG emissions, and developing or enhancing carbon sinks, to support the objective of stabilising atmospheric GHG concentrations ‘at a level that would prevent dangerous anthropogenic interference with the climate system’ (UNFCCC, Art. 2). At the global level, the three ‘sectors’ that are the biggest contributors to GHG emissions (namely energy generated from fossil fuel burning, agriculture, and land use change –especially deforestation) are also the main choices for emission reductions (Herzog 2005). Globally, the *largest potential for curbing GHG emissions* lies in:

* improving energy efficiency (across all uses/sectors);
* relying more on low-carbon technologies to generate heat and power;
* opting for more sustainable modes of transport;
* curbing deforestation (and stopping desertification);
* and modifying agricultural practices (e.g. more efficient use of nitrogen-based fertilisers, improved management of manure) (IPCC 2007d, Stern 2007, EC 2009a, McKinsey & Company 2009).

1. At the national level, country-specific patterns of emissions and circumstances (including development objectives and priorities) should be considered when determining national priorities for mitigation. Developing countries should also consider the existence of opportunities linked to international carbon finance flows. The ultimate goal is to ensure that the chosen development path addresses sources of emissions.
2. Commitments under *Multilateral Environmental Agreements* (MEAs) are a starting point for defining some key resilience-oriented measures through the associated Action Plans (e.g. under the Convention on Biological Diversity, the Convention to Combat Desertification, the Ramsar Convention on wetlands, the Stockholm Convention on Persistent Organic Pollutants, etc). Regional conventions are also useful in this respect. However, Action Plans under MEAs are often not fully integrated and harmonised into the wider policy system, often resulting in unsatisfactory implementation and a shortage of funds designated to that effect.
3. Many developing countries have now submitted their national adaptation programmes of action (NAPAs) and nationally appropriate mitigation actions (NAMAs) to the UNFCCC Secretariat:
   * NAPAs were promoted to help least developed countries (LDCs) raise awareness, build national capacities and identify priority adaptation projects with developmental benefits. Non-LDCs have not prepared NAPAs, but many have national climate action plans or equivalent documents – and the majority of UNFCCC signatory countries have now submitted their first (and increasingly their second) National Communications under the Convention.
   * NAMAs are voluntary mitigation measures consistent with a country’s development strategy, that are meant to put it on a more sustainable development path.

Both are good starting points for addressing the climate challenge without compromising development objectives – and can contribute to the mainstreaming effort if they manage to federate and to some extent replace standalone plans and measures (see Module 3).

1. *Climate adaptation and mitigation should not be seen only as a constraint but also as a source of opportunity*. In many instances, the adoption of adaptation and mitigation measures actually makes a positive contribution to development objectives, and creates opportunities such as green growth, green jobs and development co-benefits (EC 2009a).
2. One of the ways for ‘climate-compatible’ development to be conducive to pro-poor economic growth is to encourage the creation of *‘green jobs’*, i.e. jobs associated with the deployment of clean technologies and the adoption of improved environmental practices. Green jobs may be associated with both adaptation and mitigation. Possible sectors for the creation of such jobs include (renewable) energy supply, public transport, manufacturing (e.g. clean technology equipment), construction (e.g. climate proofing of buildings and other infrastructure, retrofitting of buildings for improved thermal insulation), materials management (e.g. resource efficiency and recycling), retail (e.g. promotion of locally produced goods), agriculture (e.g. soil conservation, water efficiency) and forestry (e.g. afforestation, reforestation, sustainable forestry, agroforestry). Active training and capacity building policies are required to support the development of green jobs (UNEP 2008, EC 2009a).
3. The *development co-benefits* (also known as ‘ancillary benefits’) of climate change adaptation and mitigation should be specifically considered from a multidimensional perspective, including economic growth, poverty reduction, gender equality and environmental sustainability (Perch 2010). For instance:

* The development of renewable energy sources may reduce pollution from fossil fuel burning, with significant environmental and health benefits – while making the national economy less exposed to external shocks and increases in the price of imported fuels.
* Projects, programmes and strategies developed in the context of REDD+ (the global initiative for Reducing emissions from deforestation and forest degradation) may deliver benefits in terms of forest- and forestry-related livelihoods and the preservation or restoration of important ecosystem services – provided they are conceived with the participation of forest-dependent people and local communities.
* Adaptation measures for agriculture, and measures for reducing emissions from agricultural soils, may improve the livelihoods of farmers, including the many women involved in subsistence agriculture, by improving yields, reducing soil erosion and degradation, or improving water quality and availability.
* Adaptation to future climate change may entail immediate benefits in terms of reduced vulnerability to current climate risks (EEA 2007, Agrawala & Fankhauser 2008).

1. *Adaptation and mitigation* are both essential; they are like two sides of a coin, the complementary elements of the response to climate change (IPCC 2007c). Recent economic analysis shows that ‘the total costs of climate change are the lowest when both mitigation and adaptation are undertaken in conjunction’ (Agrawala et al 2010: 4).
2. There are both *potential synergies and potential conflicts or trade-offs* between adaptation and mitigation responses:
   * Although adaptation and mitigation are quite different in nature (Klein et al 2005), sometimes adaptation and mitigation measures are congruent, so that mitigation produces a double stream of benefits. For instance, reduced tillage agriculture enhances carbon sequestration in soils while supporting soil moisture retention, thus increasing resilience to dry spells; and sustainable reforestation may simultaneously enhance carbon stocks and, by offering new livelihood opportunities, enhance the adaptive capacity of local communities.
   * Mitigation measures should be compatible with adaptation policies and requirements, avoid increasing vulnerability to climate change, and rely on environmentally sustainable practices. Biofuels or agrofuels, for example, are often presented as a good mitigation option, but in practice, depending on local circumstances, may be a threat to food security, water availability and ecosystems.
   * Similarly, adaptation measures should be designed and selected taking emissions into account. For example, when opting for agricultural intensification in support of improved food security, emissions associated with the use of fertilisers should be considered; similarly, when deploying cooling systems for adapting to heat waves, users should consider emissions from fossil energy.
3. *Environmental and climate change mainstreaming is at the heart of the process of moving to green, low-carbon, climate-resilient development*: green development require the integration of environmental considerations while climate-resilient development results from adaptation mainstreaming and low-emission development results from a process of mainstreaming climate change mitigation in all policy-making and planning activities. (For explanations on the concept of mainstreaming, see Module 3.) In both cases, focusing on co-benefits can create powerful incentives for initiating and sustaining the mainstreaming process.

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**Useful websites:**

UNDP – Adaptation Policy Frameworks for Climate Change:

<http://www.undp.org/climatechange/adapt/apf.html>

UN Framework Convention on Climate Change – including links to available National Communications and NAPAs:

<http://unfccc.int>

United Nations Development Programme (UNDP) – Human Development Report:

<http://hdr.undp.org/en/>

**Annex 1.1 – Guiding questions for assessing poverty–environment linkages**

***Livelihoods and Health***

* What is the size of the population depending for their livelihoods on natural resources and ecosystem services? How many employment or informal income-earning opportunities do natural resource sectors (e.g. forestry and fisheries) and other productive sectors relying on the environment (e.g. hydropower, agriculture and tourism) provide, particularly to the poorest?
* What are the direct health and productivity impacts of air, soil and water pollution and the associated costs of inaction? What needs to be done to reduce these costs? What would be the investments required to undertake action?

***Environmental Risks and Climate Change***

* Are the country’s people and economy vulnerable to environmental risks such as floods, droughts and climate change? What are the effects and costs of environmental hazards (such as floods or pollution) in terms of health, livelihoods and vulnerability?
* How vulnerable is the country to the effects of climate change? Do the country and people have the capacity to adapt to environmental changes that could accompany climate change? What work (if any) has been done to assess potential impacts and adapt to climate change? Does the country have a disaster risk reduction policy that incorporates climate change concerns?

***Economic Development***

* How much do the country’s main natural resource sectors contribute to growth? How do natural resources contribute as inputs into other productive sectors? What percentage do these sectors represent in terms of gross domestic product? Does this take into account informal markets, and how large are these?
* Are country growth and poverty reduction targets at risk from the impacts of persistent and insidious environmental degradation? This could include, for instance, the long-term decline of crop productivity from soil erosion.

***Overall Understanding of the Linkages***

* Is there an explicit understanding of poverty-environment linkages (such as in terms of food security or access to fuelwood, shelter and clean water) within the country?
* How do various demographic groups (men and women, different age groups, different income-level groups) benefit from, or how are they affected by, these questions and linkages (in terms of their health, resilience, livelihoods, income opportunities, employment)?

**Adapted from: UNDP-UNEP (2009) *Mainstreaming Poverty-Environment Linkages into Development Planning: A Handbook for Practitioners*. Box 4.3, p. 29.**

**Annex 1.2 – Guiding questions for assessing climate–development–poverty linkages**

***Climate and environment***

* What is the climate situation (average climate parameters, climate variability, seasons, frequency of extreme weather events,...)?
* What is the state of the environment?
* How does the current climate interact with other drivers of environmental change to impact on ecosystems and their services?
* Could climate change exacerbate existing environmental problems or aggravate negative environmental trends?

***Vulnerability and adaptation***

* What population groups, sectors and regions are most vulnerable to the impacts of current climate variability? And to those of future climate change?
* Why are they at greatest risk (e.g. poverty, degraded natural resources, lack of infrastructure)? What are the key factors contributing to vulnerability?
* How could climate change impacts exacerbate existing vulnerabilities?
* What is the current situation with respect to climate change adaptation? Is there an adaptation deficit?

***Development and poverty reduction***

* What are the links between current and future climate and national development priorities/key sectors?
* To what extent could climate change jeopardize the achievement of certain development objectives (e.g. the MDGs)?
* Do existing policies, strategies and programmes increase the risk of maladaptation, and/or contribute to enhancing adaptive capacity and reducing vulnerability?
* Do current development policies and strategies contribute to increased or reduced greenhouse gas emissions? Is there a potential for reducing emissions and/or enhancing carbon sequestration?
* If so, what are the implications of realising this potential on livelihoods, economic growth, poverty reduction, employment, human health, and other components of human wellbeing?

**Adapted from: UNDP-UNEP (2011) *Mainstreaming Adaptation to Climate Change into Development Planning: A Guide for Practitioners*. Box 4.1, p. 20.**

1. ‘Green infrastructure’ refers to the life-supporting and regulation services provided by the natural environment and ecosystems (EC 2009a); it has been defined as ‘the network of open space, woodlands, wildlife habitat, parks and other natural areas that sustains clean air, water and natural resources and enriches our quality of life’ (Benedict & McMahon 2001:3). [↑](#footnote-ref-1)
2. Burton and van Aalst (2004: 15) note that ‘many projects and development plans are well in tune with the climate normals (average conditions), but tend to pay less attention to the risks associated with climate variability and extreme events’. [↑](#footnote-ref-2)
3. Both agriculture and energy supply and use offer significant opportunities for promoting low-carbon development paths while increasing adaptive capacity. [↑](#footnote-ref-3)