XI Assessment of Investment & Financial Flows for Adaptation in the Biodiversity Sector

11.1 Introduction

The Convention on Biological Diversity (CBD) defines biodiversity as "the variability among living organisms from all sources including, inter alia, 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."[135] In this regard, biodiversity also comprises the specific genetic variations and traits within species, as well as the assemblage of these species within ecosystems.

As highlighted in the Millennium Ecosystem Assessment[136], climate change is one of the most important drivers of biodiversity loss and is projected to further adversely affect the role of biodiversity as a source of goods and services. Some examples of biodiversity loss are:

- Changes in climatic variables have led to increased frequency and intensity of outbreaks of pests and diseases.
- Changes in stream flow, floods, droughts, water temperature, and water quality have been observed and they have affected biodiversity and the goods and services ecosystems provide.
- Coral reefs have been adversely affected by rising sea surface temperatures.
- Diseases and toxicity have affected coastal ecosystems.
- Changes in marine systems, particularly fish populations, have been linked to large-scale climate oscillations.
- Large fluctuations in the abundance of marine birds and mammals have been detected and may be related to changing regimes of disturbances, climate variability, and extreme events.
- Changes in forest vegetation types due to climate oscillations.
- Substantial species–range shifts as a result of warming and drying trends.
- Extinction for endemic species in various mountain ecosystems caused by habitat loss.

Climate change adaptation activities can promote conservation and sustainable use of biodiversity and reduce the impact of changes in climate and climatic extremes on biodiversity. A more dynamic and proactive approach to biodiversity management is also required to incorporate ecosystems into climate policy. This is likely to demand a fundamental review of

[135] Convention on Biological Diversity, Art. 2. United Nations Treaty series, 1993.
[136] Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-being: Synthesis. Island Press, Washington, D.C.

biodiversity and ecosystem management regulatory frameworks, including the way in which protected species and area designation is determined and applied.

Further, the action to reduce other drivers of biodiversity loss (i.e., deforestation, spread of invasive species, pollution, over exploitation) will be crucial to improve resilience and make biodiversity more robust to future changes.

There are limited adaptation options for some ecosystems (e.g., coral reefs and high latitude areas) because of their sensitivity and/or exposure to climate change. For some of these systems, adaptation options may include limiting other pressures. For example, conservation of biodiversity is strongly targeted at protected areas.

Some examples of adaptation activities and their potential impact on biodiversity identified in the IPCC Technical Paper V on Climate Change and Biodiversity[137] are the following:

Integrated land and water management (or landscape management):

- Removing policy distortions that result in loss and or unsustainable use of biodiversity
- Developing and establishing a methodology that allows examination of tradeoffs between meeting the human needs and conservation and sustainable use goals
- Establishing extensive land management programs
- Planting/forestation to overcome land and water degradation
- Controlling invasive species
- Cultivating wild food and medicinal species

Integrated approach to coastal fisheries management, including the introduction of aqua and mariculture:

- Aqua and mariculture would reduce the impact on the remaining coastal systems, but may be best implemented when considered as part of integrated approach to coastal management

Integrated approaches aimed at enhancing sustainable agriculture and rural development simultaneously:

- Appropriate management of agricultural production systems
- Improved shifting cultivation with sufficient fallow periods
- Diversification of cropping systems
- Continuous ground cover
- Nutrient restoration
- Agroforestry systems that involve various combinations of woody and herbaceous vegetation with agricultural crops

[137] IPCC (2002). IPCC Technical Paper V, Climate Change and Biodiversity.

Moving species to adapt to the changing climate zones:

- Assistance for some species for a time by providing natural migration corridors (e.g., by erecting reserves of a north-south orientation)

Reduction of use of pesticides and herbicides in response to new pest species:

- Avoid damage to existing plant and animal communities, water quality and to human health

Water use efficiency:

- In response to increasing demand for water use due to socio economic conditions and warmer temperatures, and exacerbated by decreased precipitation in some regions

Avoid physical barriers built as adaptation measures to cope with present climate variability:

- Enhancement and preservation of natural protection (e.g., replanting of mangroves and protection of coral reefs)
- Artificial beach nourishment
- Raise the height of the ground of coastal villages
- Strategic placement of artificial wetlands

"Precautionary" approaches:

- Enforcement of building setbacks
- Land use regulations
- Insurance coverage

Long term success for these adaptation strategies depends on meeting the economic needs of communities whose livelihoods already depend to varying degrees on biological resources and the ecosystem services biodiversity support. The effectiveness of adaptation activities can be enhanced when they are integrated with broader strategies designed to make development paths more sustainable. There are potential environmental and social synergies and tradeoffs between climate adaptation activities (project and policies), and the objectives of multilateral environmental agreements.

11.2 Application of I&FF Methodology to Adaptation in the Biodiversity Sector

This section describes how the I&FF methodology presented in Chapter II should be applied to adaptation in the biodiversity sector.

Step #1: Establish key parameters of assessment

>>> Define detailed scope of sector

In this step, the precise components of the biodiversity sector that are to be included in the I&FF assessment must be defined. Biodiversity is comprised of three main components, genetic diversity (variety of individuals within one and the same species), species diversity and ecosystems diversity (includes a variety of woodlands, deserts, fields, rivers, seas, oceans and other bio-communities interacting with each other and with the non living environment). The definition of the biodiversity sector and whether all possible components, that is the different existing ecosystems (see Table 11-2), are to be examined, or only a subset within the sector, will need to be addressed early on in the process of assessment. The precise components that are to be included in the I&FF assessment must be defined such that the specific activities, entities, and geographic regions that are encompassed by the biodiversity sector as defined by the national team for the I&FF assessment are clear.

Which components are included, and exactly how broadly or narrowly they are defined, should depend on national circumstances – including existing ecosystems, known species, endemic species and soil characteristics, among others – and according with the vulnerability assessment of the ecosystems existing in the country. The following table (Table 11-1) lists the type of information provided by the vulnerability assessment for each ecosystem in a certain country.

Table 11-1: Example of vulnerability assessment for the biodiversity sector

Vulnerability assessment			
Ecosystem A	*Ecosystem B*	*Ecosystem C*	*Ecosystem D*
Annual average temperature	Annual average temperature	Annual average temperature	Annual average temperature
Annual average precipitation	Annual average precipitation	Annual average precipitation	Annual average precipitation
Characteristics	Characteristics	Characteristics	Characteristics
Geographical distribution	Geographical distribution	Geographical distribution	Geographical distribution
Conservation situation	Conservation situation	Conservation situation	Conservation situation
Impacts on the conservation situation	Impacts on the conservation situation	Impacts on the conservation situation	Impacts on the conservation situation

Source: Author's Assessment

The choice of which components are included should also depend on data availability, the structure of national government entities in which data reside, and the scope of related assessments that have been completed, especially analysis of direct and indirect impacts of climate change identified as part of the national communications, vulnerability assessments and other adaptation studies that may have been completed.

In addition, it is important that the scope avoids overlap with other sectors (e.g., water, agriculture, forestry, food security) that might also be assessed.

Some adaptation measures and activities will also result in mitigation benefits in the same sector or another sector. The focus on adaptation does not imply that mitigation opportunities and potential for emission reductions are unimportant or irrelevant in the biodiversity sector. Sea surface temperature increase and elevated CO_2 concentrations could result in reduced species diversity in coral reeds and more frequent outbreaks of pests and disease in the reef system. The effects of reducing the productivity of reef ecosystems on birds and marine mammals are expected to be substantial. Water use efficiency opportunities and measures could be envisaged across the sector.

>>> Specify assessment period and base year

This methodology recommends a 25-year assessment period and 2005 as the base year. If another year must be used for the base year due to data limitations or other national circumstances, it is recommended that the assessment period should still be 25 years in length because of the long lifetimes of capital stock and infrastructure in the sector.

>>> Identify preliminary adaptation measures

A preliminary set of adaptation options must be identified for each component of the biodiversity sector, or ecosystem/s, included in the assessment, which will inform the design of the analytical approach. The adaptation options that are chosen should be much more specific than those listed above so that I&FF, and O&M costs, can be estimated in Step 6.

Climate change will impact on biodiversity through a multiplicity of direct and indirect pathways whose importance will vary depending on the type of ecosystem as shown in the pathways identified in Table 11-2.

Table 11-2: Examples of potential impact pathways[138]

Ecosystem	Vulnerabilities	Impacts
Deserts	Desiccation and soil mobilization Drier and warmer conditions	More episodic climate events and inter-annual variability may increase in future More severe and persistent droughts
Grasslands and savannas	Warming Fire regime changes Increased rainfall variability	Vegetation affected Production and soil water balance
Mediterranean	Warming Desertification	Desert and grassland expansion Fire frequency and fire extent Rainfall frequency reductions
Forests and woodlands	Forest dieback Drought	Mortality and a potential reduction in resilience Insect outbreaks
Tundra and Artic/Antartic	Species extinction Paludification Thermokarst processes Dryness	Threats to the livelihoods and food security
Mountains	Earlier and shortened snow melt period Water shortage Extinction for many endemic species	Genetic diversity reduction within species Reshuffling of species Increase in evapotranspiration
Freshwater wetlands, lakes and rivers	Raising temperatures	Dependence on water availability controlled by outside factors Lower water quality
Oceans and shallow seas	Higher seawater temperatures Declining carbonate	Increasing thermal stratification and reducing upwelling Sea level rise Increases in wave height and frequency Loss of sea ice Risk of diseases in marine biota

Given the numerous linkages between biodiversity and other sectors, the potential for synergies between biodiversity adaptation, and mitigation and adaptation in other sectors, is large. For example, forest conservation measures may reduce species loss in the forest. It is not expected that countries will undertake integrated I&FF assessments (i.e., integrated across sectors), but countries should be alert to such synergies and cross sectoral impacts, and discuss them qualitatively in their reports.

Although climate change is a global issue, local efforts can help maintain and enhance resilience and limit some of the longer-term damages from climate change. Adaptation of these

[138] Based on Fischlin, A., G.F. Midgley, J.T. Price, R. Leemans, B. Gopal, C. Turley, M.D.A. Rounsevell, O.P. Dube, J. Tarazona, A.A. Velichko (2007). Ecosystems, their properties, goods and services. Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, 211-272.

ecosystems involves only reactive, autonomous responses to ongoing climate change. However, ecosystem managers can proactively alter the context in which ecosystems develop.

Diverse options for policy-based adaptation to climate change have been identified for biodiversity. Natural resource management techniques can be applied to increase resilience of ecosystems. Increasing resilience is consistent also with the “ecosystem approach” developed by the CBD which is a “strategy for management of land, water and living resources that promotes conservation and sustainable use in an equitable way”:

- Expansion of reserve systems, can potentially reduce the vulnerability of ecosystems to climate change. Such as, industry standards on biodiversity and protected areas in the mining sector.
- Reduce and manage other stresses on species and ecosystems, such as habitat fragmentation and destruction, over exploitation, eutrophication, desertification and acidification. For example, overfishing avoidance through allowances; culture native species by means of aquaculture.
- Increase in agricultural productivity, facilitating the reduction and fragmentation of habitats. For example, a more efficient use of irrigation water and development of agriculture.
- Policies focused on managing areas outside protected areas, achieved, for example, through the devolution of resource ownership and management to communities, securing community tenure rights and incentives for resource reutilization. Also policies avoiding shipping disasters (e.g., oil spills), for example.
- Migration strategies, implemented over larger regions and across national borders.
- Controlled burning and other techniques to reduce fuel load and the potential for catastrophic wildfires.
- Securing water rights to maintain water levels trough a drought or by having infrastructure capable of surviving floods, in order to minimize the effect of severe water events. Also hydropower engaged with regional planning efforts.
- Disperse population policies to minimize the probability that localized catastrophic events (i.e. hurricane, flood, and typhoon) will cause significant negative effects.
- Restoration of habitats currently under serious threat, or creation of new habitats in areas where natural colonization is unlikely to occur. An approach of encouraging restoration habitats could be through standardization and certification of ecotourism practices in order to promote its development.

In addition, adaptation strategies will require to be context and location specific and to consider impacts both in the short and long term. All three levels at which adaptation actions might be implemented (national, regional, community) can be considered and integrated into the assessment if they are identified as parts of a national strategy.

The table below is shown for illustrative purposes in order to prioritize the ecosystems according to their importance in the climate system, their biodiversity value and the other ecosystem services they provide, and the value of these to human wellbeing. This matrix would provide a transparent framework for assessing where management or research effort should be placed as a priority. Multiple criterion decision analysis tools are required for this evaluation.

Table 11-3: Prioritization ecosystems matrix[139]

Ecosystem type	Climate regulation role	Biodiversity and ecosystem services values	Adaptation potential	Benefits for human wellbeing	Co-benefits
Wetland	Carbon store	High	High	Medium	High
Tropical forest	Carbon store, water cycling	Very high	High	High	Very high
Oceans	Carbon sink, water cycling	High	Low/medium	High	Medium
Coral reefs	Carbon cycle	Very high	High	High	High

Once populated with evidence supported by peer-reviewed literature, the matrix approach proposed will enable policy makers to identify available options for achieving co-benefits for climate change, biodiversity and human livelihoods.

There is a need for the development of accurate methodologies for identifying and quantifying the value of climate regulation and biodiversity in terms of human wellbeing and adaptation objectives.

>>> Select analytical approach

The analytical approaches that could be used for an I&FF assessment of adaptation in the biodiversity sector range from simple spreadsheet models that can be built by members of the project team to models that identify or highlight the interactions between economic and ecological dynamic systems. A combination of approaches, e.g., a bio-economic model supplemented with spreadsheet analyses, however, could also be used.

Modelling the changes in biodiversity in response to climate change presents some significant challenges. It requires projections of climate change at high spatial and temporal resolution and often depends on the balance between variables that are poorly projected by climate models. It also requires an understanding of how species interact with each other and how these interactions affect the communities and ecosystems of which they are part.

Given that biodiversity cannot be assessed directly, it will need to be operationalized through certain indicators to make it operable for the I&FF assessment. Existing project, sectoral and regional level environmental and social impact assessments can be adapted and used to measure the impacts of adaptation activities on biodiversity and other aspects of sustainable development.

[139] Based on biodiversity-climate interactions: adaptation, mitigation and human livelihoods, The Royal Society, June 2007.

- Environmental and socio-economic impacts of climate change adaptation activities can be assessed through project and strategic level (sectoral and regional) environmental and social impact assessments.
- Wide range of decision analytic frameworks can be used to evaluate climate change adaptation activities. The set of decision analytical frameworks includes decision analysis, cost-benefit analysis, cost-effectiveness analysis, and the policy exercise approach.
- Criteria and indicators consistent with national sustainable development objectives could be developed and used for assessing and comparing the impacts of adaptation activities on biodiversity and other aspects of sustainable development. For example:
    - Number of endemic species
    - Total number of known species
    - Number, extension and percent area coverage for protected areas
    - Fire frequency
    - Rainfall frequency
    - Insect outbreaks

The linkages among local, regional, and global environmental issues (including conservation and sustainable use of biodiversity) and their relationship to meeting human needs offer opportunities to capture synergies in developing response options and reducing vulnerability to climate change.

The goal of a planning assessment must be specific to the area, focusing on the issues that are pertinent to that area. This level of assessment is data and time intensive and often ongoing; though, the results, while site-specific, should be appropriate to influence future policy and to feed into more local management plans.

Step #2: Compile historical I&FF data and other input data for scenarios

>>> Compile annual historical IF and FF data, disaggregated by investment entity and source

As mentioned above, biodiversity cannot be assessed directly, but will need to be operationalized through certain indicators. The methodology recommends that countries compile 10 years of historical I&FF data, i.e., for the base year and the previous nine years. At a minimum, countries should collect at least three years of data (i.e., for the base year and two years during the previous decade). Data should be compiled for each investment type, and should be annual, be disaggregated by investment entity, and, if possible, by funding source, and also be divided into investment flows and financial flows (see Table 2-3 in Chapter II).

In the biodiversity sector, investment flows would include assets such as artificial beach nourishment, coastal village height, artificial wetlands, etc. Investment flows would also include assets for research, education, assistance, policy and institutional arrangements. Financial flows would include non-asset investments in the research, education, assistance, and institutional areas (e.g., labour costs).

The I&FF data needed (indicators chosen) will likely reside in several domestic locations (e.g., national accounts, ministry records and plans, industry records, statistical agencies, extension agencies, research institutions). Of particular interest towards data collection are the national statistical agencies and research institutes. After the information has been collected and compiled, the national team has to decide on how to organize the available information and complete Table 2-4, which specifies the amount of I&FF per year, for each kind of investment type, according to the policies and measures, plans, actions, programmes, activities, and projects that are being implemented, considering the origin of these investments.

To facilitate the task, the following table (Table 11-4) lists the different investment and financial flows types that are being made in the biodiversity sector. It is necessary to bear in mind that the purpose of this table is to organize the information that is going to constitute the set of inputs to complete Table 2-4, as presented in the General Methodology in chapter 2.

Table 11-4: Examples of investment flows and financial flows in the biodiversity sector

Year 2005		
List of Investment flows and financial flows	**IF (2005 US$)**	**FF (2005 US$)**
Government		X
Policies and measures Relocation allowances Fiscal incentives Emergency funds Contingency plans		
Regulations Concessions Limits in the access to resources		X
Government / private	X	
Land and water management Reforestation Sustainable forest management Invasive species control Wild food and medicinal species cultivation	X	
Integrated coastal fisheries management		X
Sustainable agricultural and rural development Agroforestry systems Reduction on pesticides and herbicides use		X
Moving species Reduce and manage other stresses on species and ecosystems Migration strategies		X
Water use efficiency		X
Physical barriers avoidance Natural protection Expansion of reserve systems Artificial beach nourishment Coastal village height Artificial wetlands	X	
"Precautionary" activities Enforcement of building setback Land use regulation Insurance	X	
Controlled burning and other techniques		X
Training Job diversification Use of new technologies Management Education and communication programs		X
Research Forecasting Risk analysis Resource monitoring		X

X Indicates likely type of flow

>>> Compile annual historical O&M data, disaggregated by investment entity and source

Historical O&M data are also needed to provide a historical basis from which to estimate future O&M costs for new physical assets, as well as to provide data for the first year of the scenarios.

In the biodiversity sector, O&M would include the costs associated with management plans (e.g., coastal fisheries management, agricultural and rural development plans, forestry management plans, water efficiency use plans, etc.) such as labour costs, fuels and power costs, etc., according with the adaptation measures selected, and also associated costs with research, education, assistance, and institutional areas.

Annual O&M costs for the physical assets that are in operation during the historical period should be collected (or estimated) for the same years for which historical I&FF data are collected.

The O&M data that need to be collected may reside in one or more of same locations for I&FF data (e.g., national accounts, ministry records and plans, industry records, statistical agencies, utilities, research institutions). If such data are not available, countries should utilize one of the following approaches to derive estimates:

- Adopt O&M cost data from similar assets in other countries, and adjust the O&M data to in-country production and consumption rates.
- Derive estimates from proportional relationships between O&M costs and total costs, or between O&M costs and capital costs (e.g., 10%, 25%, or 75%). Use either standard assumptions about proportional relationships, or proportional relationships observed in other countries.

>>> Compile other input data for scenarios

In addition to historical I&FF and O&M cost data, the characterization of the scenarios and estimation of annual costs for the scenarios will require the collection of other historical and non-historical data relevant to the sector. What data are needed will depend on the sectoral scope and analytical approach. The kinds of information that will be needed may include:

- Characterization of the biodiversity sector, through indicators selected, including past trends and current trends, etc.
- Characterization of adaptation options, including technical feasibility, cultural acceptability, scalability, costs (capital and O&M), and economic feasibility. For example, any new technology relevant to biodiversity and climate change (e.g., coastal defences, herbicides and pesticides development, agroforestry systems), natural resources available to assist in adaptation strategies (e.g., natural barriers), existence of disaster response plan, awareness and knowledge.
- Possible externalities and linkages with other sectors should be noted and described, such as energy, agriculture, water resources and tourism, all of them related with the biodiversity sector.

- Information about major sectoral and macroeconomic policies (both recent and expected) that could significantly affect the evolution of biodiversity should also be collected, for example agriculture promotion reduces vegetation species.

If a country chooses to include subsidies explicitly in the I&FF assessment, annual costs of subsidies for each type of investment during the historical period should be collected (or estimated) for the same years for which historical I&FF data are collected. Subsidies should be compiled separately for IF, FF, and O&M (see Table 2-5 in Chapter II).

Step #3: Define baseline scenario

This step entails describing what is likely to occur in each biodiversity component without adaptation to climate change over the assessment period.

The national team should ensure that the analysis of the evolution of the baseline scenario is not a static one by considering the expected trends in the key variables that constitute the main elements that define the baseline scenario. For the baseline scenario a set of assumptions on the likely evolution of those variables should be defined on the understanding that the historical trends will persist with no substantial changes other than the potential deterioration of the conditions which determine the current situation.

The overall evolution would show that the large-scale climate-related changes in biodiversity will likely bring either increased economic hardship or missed opportunities for countries that depend upon its biodiversity but lack capacity to adapt. However, measures that would be introduced to address some of the current circumstances and conflicts, as sustainable use regulations, improved standards, management decisions on market approaches, codes of conduct and others, if currently being under consideration or implemented, should also be included in the baseline scenario.

A model can be used in the analysis, to develop and define the baseline scenario. Otherwise a sector plan, a projection of trends, or the current situation (assuming no change), or some combination, can be used as the basis of the projection.

In cases in which countries have been increasingly aware of climate change adverse effects and have already made progress in addressing climate change, these measures should be reflected in the baseline scenario, rather than trying to separate out current action on climate change.

Step #4: Derive I&FF estimates for baseline scenario

>>> Derive annual IF and FF estimates, disaggregated by investment entity and source

The source of these data, or method of derivation, will depend on the analytical approach to be used, the scope, and the types of investment entities that are relevant for biodiversity. The I&FF estimates may be the output from a model, and/or might be obtained from a planning document or from several documents, and/or might be derived from the historical data. If a model is not used, information may be available from the investment entities, and/or relevant government ministries or statistical agencies, and/or research institutions, as appropriate.

The output of this step will be a stream of annual investment flows and/or financial flows for each investment type in each subsector for the entire assessment period, by investment entity and funding source. These data should be organized as in Table 2-3 in Chapter II.

>>> Derive annual O&M estimates, disaggregated by investment entity and source

Annual estimates of O&M costs for assets purchased during the assessment period, and for assets purchased before the assessment period and that are expected to still be in operation, need to be collected (or derived) for each subsector.

If a country chooses to include subsidies explicitly in the I&FF assessment, annual subsidy costs should be estimated for each relevant investment type, and for all categories of cost (IF, FF, and O&M), in the baseline scenario (see section 2.2.1 of Chapter II).

Step #5: Define adaptation scenario

This step entails developing a description of what is likely to occur in each relevant biodiversity component, over the assessment period, with implementation of additional adaptation measures. This would include comprehensive descriptions of the specific adaptation measures that would be implemented and the implications of those measures for the evolution of the components (e.g., reduction in water shortage). The vulnerabilities that the adaptation measures are designed to reduce, and the climate changes from which vulnerabilities were assessed, should be described as well.

The adaptation measures need to be defined clearly and completely so that IF, FF, and O&M costs can be estimated in the next step. This should include specific information about facility and infrastructure investments that would occur in each component (e.g., coastal village height), as well as non-asset investments (e.g., education program). In-country expertise, and prior work on climate change adaptation (e.g., National Communications, National Adaptation Programmes of Action (NAPAs)), should be utilized in this step.

As part of the re-evaluation and initial prioritization of adaptation measures, countries should assess qualitatively the environmental and socioeconomic benefits, as well as potential non-investment costs (negative externalities), of the adaptation measures. Potential environmental and socioeconomic benefits might include increase in agricultural productivity due to slowing soil erosion, increased food security throughout agroforestry habitats creation, increased efficiency in the generation or use of fossil fuel based energy, increase in tourism flows as a result of ecotourism development, etc.

Step #6: Derive I&FF for adaptation

>>> Derive annual IF and FF estimates, disaggregated by investment entity and source

In this step, annual IF for the adaptation scenario facility and infrastructure investments, and annual FF for the adaptation scenario research, education, assistance, and institutional investments, are estimated for each component.

The output of this step will be a stream of annual investment flows and/or financial flows for each investment type in each subsector for the entire assessment period, by investment entity and funding source. These data should be organized as in Table 2-3 in Chapter II.

>>> Derive annual O&M estimates, disaggregated by investment entity and source

The output of this step will be a stream of annual O&M costs for each investment type for the entire assessment period, disaggregated by investment entity and source.

Step #7: Estimate changes in I&FF needed to implement adaptation

The changes in IF, FF, and O&M costs that are needed to implement the adaptation measures in each component are calculated in this step by subtracting baseline scenario costs from adaptation costs. There are two primary objectives of this step: 1) to determine how cumulative IF, FF, and O&M costs would change; and 2) to determine how annual IF, FF, and O&M costs would change. These calculations, which should be completed for each subsector, are described in detail in Chapter II.

Five separate sets of calculations should be completed – two for estimating changes in cumulative IF, FF, and O&M, and three for estimating changes in annual IF, FF, and O&M. In addition, if subsidy costs are included explicitly in the assessment, the changes in subsidy costs may be calculated. The accompanying volume on reporting (Reporting Guidelines for the Assessment of Investment and Financial Flows to Address Climate Change) contains worksheets that can be used as models for developing country-specific worksheets for performing these calculations.

Step #8: Evaluate policy implications

The purpose of this step is to evaluate the policy implications of the results of the previous step for the sector. The analyses in the previous step estimate the magnitudes and timing of changes in IF, FF, and O&M by each investment entity and from each funding source that would be needed to implement the adaptation measures in each subsector.

It is recommended that countries first re-evaluate their initial prioritization of the adaptation measures that was undertaken in step #5, based upon the incremental cost estimates, and determine which investment entities are responsible for the most significant (largest and/or highest priority) changes in I&FF, and the predominant sources of their funds. Then, the policy measures that might be used to induce those entities to implement the proposed measures and change their investment patterns, and the additional sources of funds that might be utilized to meet new investment needs, need to be evaluated. It will be particularly important to distinguish between public and private sources of finance, as well as between domestic and foreign sources. Policy measures include a variety of instruments, including economic instruments (e.g., taxes), regulatory instruments (e.g., fuel portfolio standards), voluntary agreements, information dissemination and strategic planning, and research, development, and demonstration (RD&D).

The evaluation should allow the formulation and implementation of appropriate policies at the national and at the regional scale, considering the broader view of exposure and vulnerability patterns in the country, and eventually facilitate comparison across natural resource-dependent industries, potentially providing insight into and allowing for the consideration of processes that cause and exacerbate vulnerability in countries participating of the assessment.

In that regard there is a critical need for design and implementation of sound public policies to minimize impacts of climate change and enhance adaptive capacity in the biodiversity sector in order to reduce ecosystem vulnerability, by, inter alia:

a) Building institutional and legal frameworks that acknowledge climate change impacts and consider them in conjunction with other existing pressures in the sector as well as with other relevant sectors at the country level.
b) Identify and quantifying the linkages between the demands generated by human population growth and income level and their effects on a range of natural resources.
c) Analyzing the specific impacts on livelihoods related to the biodiversity sector, the exposure and vulnerability of biodiversity and the direct and indirect of climate change on food access and security.
d) Identifying, formulating and testing a range of policy options, including a framework of policy incentives, instruments and measures directed at ensuring food and infrastructure security, while preserving the environment.
e) Using and monitor environmental impacts of those and related activities in a context of increasing environmental stresses, while considering the principles and standards of the code of conduct for responsible actors.
f) Supporting initiatives, such as creation of property rights and other incentive mechanisms, and linking appropriate financing instruments for change.
g) Eliminating harmful subsidies and perverse incentives, that serves to allow unprofitable companies to continue operating and further depresses the state of the biodiversity.
h) Strengthening future management policies by providing comprehensive, long-term view of the dynamics of production and demand for resources.