3. Guidelines on biodiversity inclusive Strategic Environmental Assessment (SEA)

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4.1 Introduction

Explaining the process how the guidelines have been drafted, based on 20 case contributions through the IAIA network, internal review, external review, workshop sessions….

Linkages to the other parts of the CBD guidelines on biodiversity in impact assessment.

Explanation of the structure of this chapter

4.2 SEA, a family of tools

Strategic environmental assessment has been defined in 1996 as "the formalized, systematic and comprehensive process of identifying and evaluating the environmental consequences of proposed policies, plans or programmes to ensure that they are fully included and appropriately addressed at the earliest possible stage of decision-making on a par with economic and social considerations". [1]/ Strategic environmental assessment, by its nature, covers a wider range of activities or a wider area and often over a longer time span than the environmental impact assessment of projects. Strategic environmental assessment might be applied to an entire sector (such as a national policy on energy for example) or to a geographical area, (for example, in the context of a regional development scheme). The basic steps of strategic environmental assessment are similar to the steps in environmental impact assessment procedures, but the scope differs. Strategic environmental assessment does not replace or reduce the need for project-level environmental impact assessment, but it can help to streamline the incorporation of environmental concerns (including biodiversity) into the decision-making process, often making project-level environmental impact assessment a more effective process.

Environment only or integrated?

SEA is a rapidly evolving field with numerous definitions and interpretation in theory, in regulations, and in practise. There are also approaches that use some or all of the principles of SEA without using the term SEA to describe them. However, recent review of practises in SEA and related approaches

[1]/ Based on Sadler and Verheem, 1996.

show there is an emerging spectrum or 'continuum' of interpretation and application. At one end of the continuum, the focus is mainly environmental (what we might call 'conventional' SEA, described in the 1996 definition of SEA cited above). It is characterized by the goal of mainstreaming and up-streaming environmental considerations into strategic decision-making at the earliest stages of planning processes to ensure they are fully included and appropriately addressed. The 2001 SEA Directive of the European Union is an example of this approach.

At the other end of the continuum is a more holistic and comprehensive approach which aims to assess environmental, social and economic concerns in a more integrated manner and involves possible trade offs between these considerations in strategic decision-making and the earliest stages of planning processes. This approach is sometimes referred to as sustainability assessment (SA). (provide example)

Spatial and temporal dimensions of SEA

Another aspect characterising the SEA discussion is the broadening of the spatial and temporal horizons. In other words where EIA and earlier SEA approaches where addressing issues that could be expected in the intervention area at a relatively short time notice, the up-streaming of environmental assessment in the decision making hierarchy leads to more broader spatial and time horizons, i.e. looking at effects elsewhere (such as in other countries) and later (effects on future generations).

The ends of the continuum are characterised by table 4.1. It shows in a hypothetical but simple way that expanding the scope of an assessment in terms of fields to be addressed (strictly environmental versus integrated), or in terms of expansion of spatial and time horizons, the complexity and the number of issues to be taken into account increases. Depending on the different needs of SEA users and the different legal requirements, diverse applications of SEA approaches can be used. Obviously there is no precise 'one size fits all' methodology.

Table 4.1: simplified characterisation of the SEA continuum; each "X" represents a number of issues that needs to be incorporated in an assessment – expanding the scope, and horizons in time and space of an assessment increases complexity of the study.

Scope → *Time /space horizons ↓*	*Environmental (ecological) aspects*	*Social aspects*	*Economic aspects*
Here and now	X	X	X
Elsewhere	X	X	X
Later	X	X	X

A more recent definition proposed by the OECD[2] refers to Strategic Environmental Assessment (SEA) as "a family of tools that identifies and addresses the environmental consequences and stakeholder concerns in the development of policies, plans, programmes and other high level initiatives."

In more concrete terms, the Netherlands Commission for Environmental Impact Assessment[3] describes SEA as a tool to:

[2] OECD Development Assistance Committee Network on Environment and Development Cooperation – Task Team on Strategic Environmental Assessment.

[3] Netherlands Commission for Environmental Impact Assessment: Strategic Environmental Assessment - Views and Experiences (fact sheet at http://www.eia.nl/nceia/products/publications.htm)

1. structure the public and government debate in the preparation of policies, plans and programs;
2. feed this debate through a robust assessment of the environmental consequences and their interrelationships with social and economic aspects;
3. ensure that the results of assessment and debate are taken into account during decision making and implementation.

This means that stakeholder involvement, transparency and good quality information are key principles. SEA is thus more than the preparation of a report; it is a tool to enhance good governance. SEA can be a formal procedure laid down by law (e.g. the SEA Directive of the European Union) or used flexibly/opportunistically.

SEA and EIA: a hierarchy of tiered instruments

SEA is described as a tiered or layered process in which decisions on a higher level influence decision making at lower level. In an idealised situation the process starts with a policy broadly describing objectives and setting the context for proposed actions, usually with a sectoral or geographic scope. Policy objectives are translated into an action plan, further operationalised in programmes; actual implementation is done through projects (see figure 4.1). Impact assessment at project level is governed by, often legally embedded, EIA procedures, while impact assessment for policies, plans and programmes is done through SEA.

SEA aims to complement project-level EIA. EIA is limited in the development of alternatives since higher strategic decision have already been taken. SEA can help streamline EIA processes, particularly if it is undertaken in a tiered manner upstream from project considerations – at the level of policies, plans and programmes. SEAs at this level will consider broader environmental issues likely to be common to multiple project initiatives in a sector or in a region. It can thus have the effect of focusing subsequent EIA processes on impacts specific to individual proposals – and therefore improving efficiency and effectiveness of the overall process.

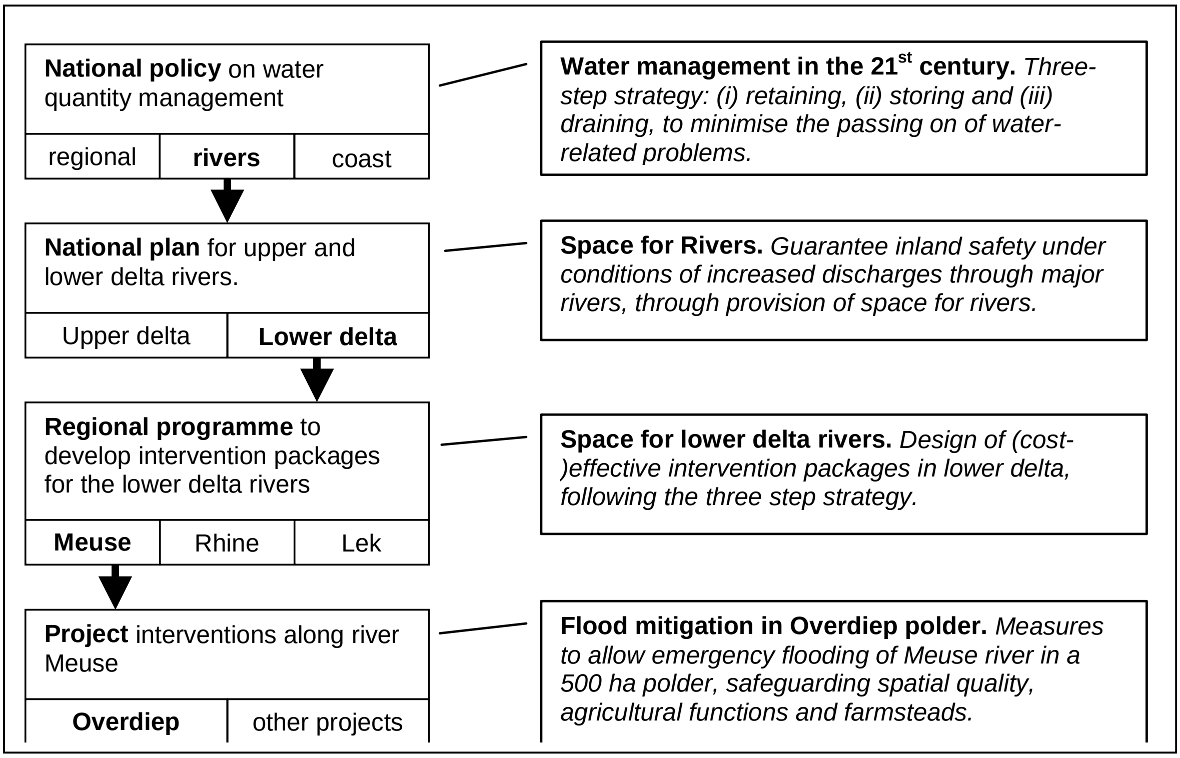

Figure 4.1: hierarchy of policies, plans and programmes: an example from the Netherlands

Parallel to or integrated within a planning process?

Starting points for SEA design are the national context and the characteristics of the planning processes in which SEA is applied. Traditionally, SEA is often applied as a stand alone process, parallel to planning. This is a good way of learning how to do SEA. From here, SEA can be further developed into its most effective form: integrated in the planning process, bringing stakeholders together during key stages of the planning process and feeding their debate with reliable environmental information. (See figure 4.2). In some cases planning procedures may be weak or absent; SEA may then structure the planning process.

Ideally SEA is integrated throughout the development process of a specific legislation, policy, plan or programme, starting as early as possible. However, even when decisions have already been taken, SEA can play a meaningful role in monitoring implementation. For example, to decide on necessary mitigating actions or to feed into future renewal of decisions. SEA may even get the form of a sectoral assessment used to set the agenda for future policies and plans.

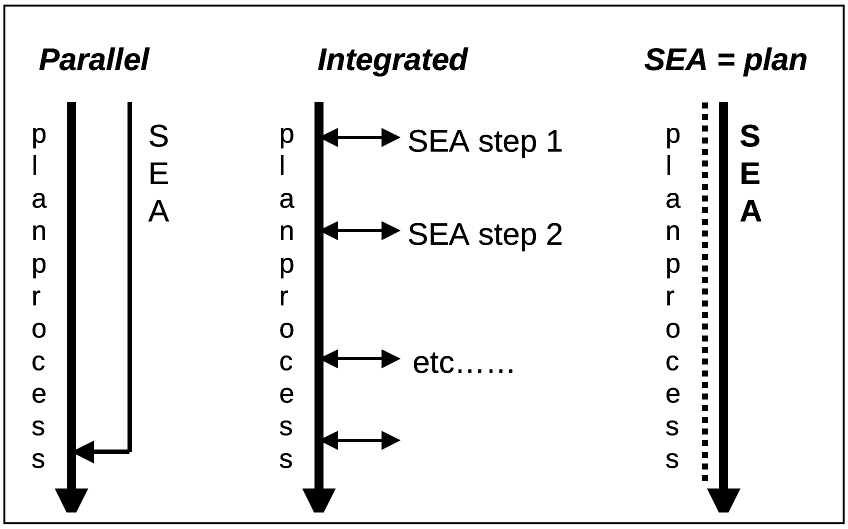

Figure 4.2: combinations of SEA and planning process

Steps in the SEA process

As EIA aims at better projects, SEA aims at better strategies, ranging from legislation and country-wide development policies to more concrete sector and spatial plans. The variation in application is reflected in the number of existing definitions for SEA. In spite of this diversity in definitions, all good practice SEAs do comply with common basic performance principles represented by IAIA's SEA Performance criteria (www.iaia.org, see annex 1 to this chapter), and with common procedural principles. When a decision on the need for an SEA has been taken, 'good practice SEA' can be characterised by the following phases[4]:

- **First phase - create transparency**

  - Announce the start of the SEA and assure that relevant stakeholders are aware that the process is starting.

[4] OECD Development Assistance Committee Network on Environment and Development Cooperation – Task Team on Strategic Environmental Assessment.

- Bring stakeholders to develop a shared vision on (environmental) problems, objectives, and alternative actions to achieve these.

- Check in cooperation with all agencies whether objectives of the new policy or plan are in line with those in existing policies, including environmental objectives (consistency analysis).

- **Second phase – technical assessment**

  - Make clear terms of reference for the technical assessment, based on the results of stakeholder consultation and consistency analysis.

  - Carry out a proper assessment, document its results and make these accessible for all. - Organise an effective quality assurance system of both SEA information and process.

- **Third phase - use information in decision-making**

  - Bring stakeholders together to discuss results and make recommendation to decision makers.

  - Make sure any final decision is motivated in writing in light of the assessment results.

- **Fourth phase: Post-decision monitoring and evaluation**

  - Monitor the implementation of the adopted policy or plan, and discuss the need for follow up action.

SEA is flexible, i.e. the scope and level of detail of the above steps can differ depending on time and resources available: from quick & dirty (2-3 months) to comprehensive (1-2 years).

4.3 Why biodiversity inclusive SEA - what difference does it make for decision making?

Why would biodiversity merit special attention? As stated earlier, biodiversity is an inherent part of any environmental assessment procedure. Nevertheless, it has been observed that biodiversity is interpreted in varying manners, in spite of the general recognition of the CBD definition of biodiversity. There is an apparent need to better define biodiversity in the context of environmental assessment.

Moreover, a number of practical problems is repeatedly observed. Barriers to effective incorporation of biodiversity in IA include:

- A low priority for biodiversity;
- Lack of awareness of biodiversity values and importance;
- Lack of capacity to carry out assessments;
- Lack of adequate data;
- Lack of guidance.

Reasons to pay more attention to the effective incorporation of biodiversity in environmental assessment are numerous; some important reason are summarised below:

Legal and international obligations

A simple and straightforward reason to pay particular attention to biodiversity in SEA is a legal or international obligation to do so. A number of legal obligations can be distinguished:

- Protected areas and protected species: ecosystems, habitats and species can have a form of legal protection because of a risk of disappearance from the region or total extinction. Status can range from strictly protected to some form of restriction on activities in protected areas. Activities with potential impact on such areas usually require environmental assessment
- Valued ecosystem services: ecosystem services can be subjected to some form of regulation triggering the need for environment assessment for activities potentially affecting these services. Often such services are not considered to be a biodiversity related issue and consequently fall under responsibility of other non-environmental agencies. Examples are fisheries and forestry activities, coastal protection (by dunes or forested wetlands), water infiltration areas for public water supply, recreational areas, landscape parks, etc.
- Resource base for indigenous groups: areas for indigenous groups represent a special case of ecosystem services. The areas are designated for indigenous groups as they directly depend on these areas for their livelihoods. Usually these livelihoods are partially biodiversity-based (hunters / gatherers).
- International treaties, conventions and agreements: countries may have signed international conventions such as the Ramsar convention on wetlands of international importance, or have designated areas under international treaties such as the Unesco Man and Biosphere programme. In doing so countries have created a moral, but non-legally binding, obligation to manage these areas according to internationally agreed principles.

Facilitation of stakeholder identification

The concept of biodiversity-derived ecosystem services (see chapter 2 for explanation) provides a very strong tool to identify potentially affected groups of people. By identifying the biophysical consequences of a proposed policy, plan or programme, it is possible to define changes in ecosystem services. Ecosystems are by definition multifunctional and thus provide multiple services. Each ecosystem service thus can have different (groups of) stakeholders. Policies, plans or programmes may address one particular ecosystem services, for example a water supply programme, a fisheries policy, or a forestry plan. Stakeholders directly targeted by such programmes usually are obvious; however, a change in the management of fisheries, forestry or water exploitation will lead to changes in other ecosystem services. This obviously requires the involvement of other stakeholders as well.

By taking an ecosystem services approach in describing biodiversity, indirectly affected stakeholders can be identified and invited to participate in the SEA process.

Safeguarding livelihoods & provision of economic benefits

The identification of stakeholders through recognition of ecosystem services can lead to a better understanding of how the livelihoods of people depending on biodiversity will be affected. Especially in non-industrialised countries a large proportion of rural society is directly dependent on biodiversity. As these groups may also belong to poorer and less educated strata of society, they may go unnoticed as they are not always capable to respond adequately to public consultation for SEA (see box on stakeholders and participation).

A biodiversity inclusive environmental assessment taking note of stakeholders through recognition of important ecosystem services may contribute to improve the livelihoods of relatively vulnerable groups in society.

Apart from highlighting the interest of vulnerable groups, a biodiversity perspective can also contribute to sound economic decision making. In South Africa a municipal planning study was carried out following a river catchment approach. Ecosystem services such as erosion control, water retention and supply, and recreational potential were monetised, thus providing a view on potential economic benefits and losses when planning new activities in a catchment. It also provided a means to compare catchments among each other – well preserved biodiversity represented high economic value. The study provides a ‘business case’ for biodiversity conservation at catchment level.

Maintaining the genetic base of evolution for future opportunities

When referring to the multi-faceted concept of sustainability, obviously the conservation of biodiversity for future generation is one important aspect. Two elements are important. In the first place biodiversity represents a wealth of yet unknown potential uses. Examples are the potential of biodiversity to provide medicinal drugs, material for the genetic improvement of cultivated plants, or any other application in the future development of genetic engineering. Secondly, maintaining the long-term viability of the earth requires the conservation of the mechanisms that guarantee the capacity of biodiversity to adapt to changing conditions, i.e. genetic diversity as the driver behind evolutionary adaptation. Any long term sustainability assessment has to take this aspect into account.

Box: stakeholders and participation

Impact assessment is concerned with (i) information, (ii) participation and (iii) transparency in decision making. Public involvement consequently is a prerequisite for effective impact assessment and can take place at different levels: informing (one-way flow of information), consulting (two-way flow of information), or "real" participation (shared analysis and assessment). In all stages of the process public participation is relevant. The legal requirements for and the level of participation differ among countries, but it is generally accepted that public consultation at the scoping and review stage are minimally required; participation during the assessment study is generally acknowledged to enhance the quality of the process.

With respect to biodiversity, three groupings of stakeholders can be distinguished. (N.B: note that the categories represent three levels, each higher level encompassing the earlier category):

- **Beneficiaries** of the project - target groups making use of or putting a value to known ecosystem services which are purposefully enhanced by the project;
- **Affected (groups of) people** – i.e. those people that experience, as a result of the project, intended or unintended changes in ecosystem services that they value;
- **General stakeholders:**
    - National or local government institutions having a <u>formal government responsibility</u> with respect to the management of defined areas (town & country planning departments, etc.) or the management of ecosystem services (fisheries, forestry, water supply, coastal defence, etc.);
    - Formal and informal institutions <u>representing affected people</u> (water boards, trade unions, consumer organisations, civil rights movements, ad hoc citizens committees, etc.);
    - Formal and informal institutions <u>representing (the intrinsic value of) biodiversity</u> itself (non-governmental nature conservation organisations, park management committees, scientific panels, etc.).
    - The general audience that wants to be informed on new developments in their direct or indirect environment (linked to transparency of democratic processes).

In general it can be observed that the role of institutionalised stakeholders becomes more important at higher strategic levels of assessment; at lower level the actual beneficiaries and affected people will become more important.

There is a number of potential constraints to effective public participation. These include:

- <u>Poverty</u>: involvement means time spent away from income-producing tasks;
- <u>Rural settings</u>: increased distances make communication more difficult and expensive;
- <u>Illiteracy</u>: or lack of command of non-local languages, can inhibit representative involvement if print media are used;
- <u>Local values/culture</u>: behavioural norms or cultural practice can inhibit involvement of some groups, who may not feel free to disagree publicly with dominant groups (e.g. women versus men);
- <u>Languages</u>: in some areas a number of different languages or dialects may be spoken, making communication difficult;
- <u>Legal systems</u>: may be in conflict with traditional systems, and cause confusion about rights and responsibilities for resources;
- <u>Interest groups</u>: may have conflicting or divergent views, and vested interests;
- <u>Confidentiality</u>: can be important for the proponent, who may be against early involvement and consideration of alternatives.

4.4 Biodiversity in SEA – different perspectives

The depicted continuum between conventional SEA (focused on the biophysical environment) and the broadly defined sustainability assessment (focussed on the social, economic and biophysical environments) has consequences for the way in which biodiversity is interpreted in SEA. Although the convention text is very clear on how biodiversity should be interpreted (see chapter 2 on how to interpret biodiversity), day-to-day practise shows widely different interpretations.

Biodiversity part of the *'voiceless'* environment

The conventional SEA addresses the impact of plans, programmes and policies on the biophysical environment. The reasoning behind this has always been that instruments already exist to represent the economic and social interests; furthermore, stakeholders with economic or social interests have a voice which, in the context of democratic societies with fairly high levels of literacy and organisation, can be heard. The environment does not have a voice and impact assessment is thus used as an instrument to give a voice to "the voiceless" environment, in order to balance dominant economic arguments. In practise this has led to the situation that particularly the nature conservation NGO community makes effective use of impact assessment procedures to voice their concerns. Biodiversity consequently is usually interpreted from a strong nature conservationist perspective. In this manner nature conservation becomes segregated from economic and social development, which in most countries has resulted in geographically defined conservation areas, barring other forms of development. Biodiversity has become a separate sector in a sectorally organised society. The sustainable use aspect of non-protected biodiversity has received relatively little attention.

This doesn't imply, however, that the industrialised countries do not treat biodiversity from a broad perspective. The problem with the sectoral approach in conventional impact assessment is that responsibility for biodiversity is divided over a number of sector organisations. For example the exploitation of fish or forest resources, agriculture, water quality and quantity management, etc. all have to do with (sustainable) use of biodiversity, but regulations and policies are defined by different entities that do not refer to their activities as sustainable use of biodiversity. By taking all these biodiversity-related issues linked to other sectors out of the biodiversity scope, nature conservation is left as the prominent element of biodiversity.

Biodiversity for social and economic well-being

More recently impact assessment practises have been adopted in most developing countries. In these countries the biophysical environment, including biodiversity, is not only looked at from a nature perspective, but also as the provider of livelihoods to people. Especially in rural areas social and economic development of relatively voiceless rural poor is a main goal of development. Both social/economic and biophysical environments are seen as two sides of the same coin and consequently a more integrated approach develops in these countries. Biodiversity conservation and sustainable use are equally important issues in impact assessment; decision makers have to deal with the equitable sharing of benefits derived from biodiversity in societies characterised by unequal distribution of wealth. Such integrated approaches better reflect the broad perspective on biodiversity that the Convention provides.

Merging perspectives

In recent years both the integrative, non-Western approaches and the Western style, sectorally divided approaches are nearing each other as it is being realised that the environment, including its living biodiversity component, provides goods and services that can not simply be assigned to a sector (biodiversity provides multiple goods and services simultaneously) or a geographically defined area (goods and services are not limited to protected areas only). Yet, it is also realised that certain parts of the world are of such importance for the maintenance of biodiversity, that these areas should be safeguarded for the future and require strict protective measures. In this respect it does not make a difference whether biodiversity should be protected because it has intrinsic value (the non-utilitarian view), or because it represents non-use or existence values for future generations (the utilitarian approach).

Time and space

From a biodiversity perspective spatial and time horizons are of extreme importance. In conventional SEA the planning horizon is often linked to economic planning mechanisms. Depending on the interest rate, the planning horizon lies around 15 years. Assessing the impacts on biodiversity often requires a longer time horizon. Biophysical processes such as soil formation, forest (re)growth, genetic erosion and evolutionary processes , effects of climatic changes and sea level rise, all work on other time scales and usually are not taken into account in conventional SEAs. To address the fundamental processes regulating the world's biological diversity a longer time horizon is required.

Similarly, ecosystem in the world do not function in isolation; flows of energy and nutrients link the world's ecosystems. Effects in an area under assessment may have much wider biodiversity repercussions. The most visible example is the linkage of ecosystems on a global scale by migratory animals (bird, fish, mammals, etc.); on a continental scale ecosystem are linked by hydrological processes through rivers systems and underground aquifers, etc. Biodiversity considerations consequently may require a much wider geographical focus.

Biodiversity in this document

The way in which biodiversity is interpreted in this document has been described in detail in chapter 2. Summarising the most important features that will reappear in the SEA guidelines:

- Direct drivers of change are those human interventions (activities) that lead to biophysical and social effects with known impacts on biodiversity and associated ecosystem services.
- Indirect drivers of change are societal changes, which may under certain conditions influence direct drivers of change, ultimately leading to impacts on ecosystem services.
- Aspects of biodiversity: impacts on biodiversity can best be described in terms of changes in composition (what is there), changes in structure (how is it organised in time and space), or changes in key processes (what physical, biological or human processes govern creation and maintenance of ecosystems).
- Three levels of biodiversity are distinguished: genetic, species, ecosystems. In general, the ecosystem level is the most suitable level to address biodiversity in SEA. However, situations with a need to address lower levels exist; examples are provided in the guidelines.
- In impact assessment, biodiversity can best be defined in terms of the ecosystem services provided by biodiversity. These services represent ecological, social and economic values for society and can be linked to stakeholders. Stakeholders can speak on behalf of biodiversity and can consequently be involved in an SEA process. Maintenance of biodiversity (or nature conservation) is an important ecosystem service, but as explained earlier in this chapter, biodiversity provides many more ecosystem services (see annex 3 for examples).

4.5 Is SEA needed from biodiversity perspective? Biodiversity-inclusive screening

The decision to start with an SEA process is usually not related to any biodiversity issue, as biodiversity-specific screening criteria for SEA are not yet common. When such a decision has been taken, biodiversity can, however, be identified in the scoping phase as one of the issues that needs further attention; this will be dealt with in the next section (biodiversity is <u>one of the issues</u>).

Ideally, the criteria on which a screening decision is based are biodiversity inclusive, implying that the need for an SEA can also be triggered by a biodiversity-related issue (biodiversity is <u>THE issue</u>). In this section an approach is suggested to assist in the definition of screening criteria, based on characteristics of the policy, plan or project subject to screening. These criteria are an add-on to existing criteria; they are NOT intended to replace existing criteria but merely to enhance these criteria from a biodiversity perspective.

Generally speaking, two types of screening systems are used:

- <u>Case-by-case screening</u>: for each new policy, plans or programme the need for an SEA is determined, based on expert judgement. The guidance provided below in this document can be used to asses the need for SEA from a biodiversity perspective.
- <u>Categorical screening</u> based on strictly defined categories of plans, policies or programmes that are subjected to SEA. The guidance provided below needs to be translated into context-specific criteria (e.g. country regulations, procedures within an organisation, etc.)

Impact assessment by definition has to deal with uncertainty; in the case of SEA the level of uncertainty is even higher as compared to EIA. Furthermore, the tiered nature of SEA creates a variety of contexts in which SEA is applied. To be able to make a judgement on potential biodiversity impacts of a PPP, two elements in any PPP are of overriding importance: (i) delineation of geographical boundaries, and (ii) distinctness of interventions.

The four different situation below provide guidance to determine what kind of PPP is being screened and at what level of detail biodiversity considerations can be addressed. For four different situations appropriate screening criteria are formulated. Examples of policies, plans or programme that typically fall under one of the situations are provided, but these are for illustration only. In practise, the contents of any PPP may deviate from '*the typical*'. Therefore, geographical demarcation and distinctness of interventions are leading in identifying the appropriate screening criterion for biodiversity –inclusive screening.

Situation 1: Geographical delineation of the area influenced by the PPP is possible

<u>Typical PPPs</u>: National or regional development plans are typically characterised by a clear geographical demarcation, usually having to deal with multiple, less well defined interventions.

<u>Relevance from a biodiversity perspective</u>: Geographical delineation of an area provides the most important biodiversity information as it is possible to identify the ecosystems and land-use practises in the area, and identify ecosystem services provided by the area. With known ecosystem services it is possible to identify stakeholders of these services, which facilitates stakeholder involvement in the SEA process. Area-related policies and legislation can be taken into account and dependent on availability of information and the size of the intervention area, species inventories may be available for impact assessment. This opens the possibility to also refer to special species-oriented policies or regulations.

<u>Criterion for screening</u>: An SEA is needed when (parts of) the area subject to the PPP is known to provide important ecosystem services, including the preservation of biodiversity (see Box on ecosystem services in legal context).

Box: ecosystem services in legal context

In very general terms SEA provides information on policies, plans and programmes for decision makers to choose between a number of alternative development options. SEA provides relevant information on potential environmental impacts, and depending on the approach taken in SEA it also provides information on social and economic impacts. Furthermore, SEA also examines the consistency of PPPs to the legal context. Because of the generic nature of this document the legal context has been largely disregarded.

It is important to realise, however, that ecosystem services often have formal recognition by some form of legal protection. Such legal protection consequently provides important cues for screening. Legislation often has a geographical basis (e.g. protected areas) but this is not necessarily always the case (e.g. species protection is not always limited to demarcated areas). Of course, the legal context in any country or region is different and needs to be treated as such in the further elaboration of screening criteria.

Some examples of ecosystem services linked to formal regulations:

Service: preservation of biodiversity

- Nationally protected areas/habitats, protected species;
- International status: Ramsar convention, UNESCO Man and Biosphere, World Heritage Sites
- Subject to national policies such as the U.K. Biodiversity Action Plans (BAP), the Netherlands Ecological Network (NEN), or the European Natura 2000 Network.
- Marine Environmental High Risk Areas (sensitive areas prone to oil pollution from shipping)·
- Sites identified and designated under international agreements, eg OSPAR Marine Protected Areas (MPAs)
- Sites hosting species listed under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals)
- Sites hosting species listed under the Berne Convention (Annex 1 and 2 of the Convention on the Conservation of European Wildlife and Natural Habitats, 1979)

Service: provision of livelihood to people

- Extractive reserves (forests, marine)
- Areas of indigenous interest
- Touristic (underwater) parks (service: maintaining biodiversity to enhance tourism)

Service: preservation of human cultural history / religious sites

- Landscape parks
- Sacred sites, groves
- Archaeological parks

Other ecosystem services, in some countries formally recognised

- Flood storage areas (service: flood protection or water storage)
- Water infiltration areas (service: public water supply)
- Areas sensitive to erosion (service: vegetation preventing erosion)
- Coastal defences (dunes, mangroves) (service: protecting coastal hinterlands)
- Urban or peri-urban parks (service: recreational facilities to urban inhabitants)

Situation 2: The PPP is concerned with concrete interventions with predictable biophysical consequences.

Typical PPPs: national or regional sector policies. These policies usually have no geographical demarcation, but are oriented towards sector-related interventions. From a biodiversity perspective only interventions with (direct or indirect) biophysical consequences are relevant as these impact on ecosystem services. Similarly, interventions can also result in social changes that in their turn lead to biophysical changes and impacts on ecosystem services. (For example development of a relatively untouched area will lead to land conversion, and partial direct loss of ecosystem services. The development will attract labour, people migrate into the area, leading to increasing land occupancy with further impact on ecosystem services).

Criteria for screening**:** An SEA is needed when the PPP proposes interventions that will lead to the following biophysical changes (at a significant level of effect):

- Land conversion;
- Fragmentation by line-shaped infrastructure (roads, railways, canals, dikes, powerlines, etc.) or isolation by surrounding land conversion;
- Extraction (forestry, fisheries, mining for ores and minerals, water extraction);
- Emissions and/or effluents (including chemical or thermal pollution and noise);
- Disturbance of ecosystem composition, structure or key processes (includes introduction of non-native species)

An SEA is equally needed when the PPP proposes interventions leading to significant social changes that are known to lead to one of the above-mentioned biophysical changes:

- Demographic changes due to permanent (settlement), temporary (temporary workers) or seasonal in-migration (tourism);
- Resettlement;
- Conversion or diversification of economic activities (e.g. from subsistence farming to cash crops);
- Conversion or diversification of land-use (type of activity, mix of activities, intensity of use).
- Enhanced transport and (rural) accessibility;
- Marginalisation and exclusion of (groups of) rural people (for example squatters forced to cultivate on marginal lands sensitive to erosion).

It depends on characteristics of society and the environment to know whether these changes will indeed lead to impacts on ecosystem services. Knowledge of affected stakeholders and the affected area is needed. At this level of SEA the biodiversity impacts are defined in conditional terms: impact are expected to occur when the PPP will affect certain types of ecosystems, or when the PPP affects certain stakeholders. Only at lower level elaboration of such policy or plan into an implementation programme will it be possible to identify the actual impacts when area information becomes available (see situation 3).

Situation 3: PPP defines both area under influence and interventions

Typical PPPs: programme level location and routing alternatives, technology alternatives, and spatial planning.

Relevance from a biodiversity perspective: Knowledge on both the activities and the intervention area provide the best options to define biodiversity-related impacts. A concrete description of proposed activities provides a list of social and biophysical changes that result from these activities. A concrete delineation of the intervention area provides knowledge on ecosystems and land-use practises, ecosystem services and stakeholders. By projecting social and biophysical changes on the intervention area it is possible to determine what changes will affect the composition or structure of biodiversity, or whether it will affect a key process which is of importance for the creation or maintenance of an ecosystem or land-use system (i.e. what aspects of biodiversity are affected).

Screening criteria: Since interventions and the area of intervention are known, the screening criteria from the EIA Guidelines can be applied[5].

Situation 4: PPP is concerned with interventions without direct biophysical consequences; geographical demarcation is unclear or extremely large-scale (countries, regions)

Typical PPPs: international trade agreements; poverty reduction strategy papers (PRSPs);

[5] The EU SEA directive uses a similar approach. It defines the need for an SEA for all plans and programmes which set a framework for future development consent of projects requiring impact assessment under the EIA Directive, and all plans and programmes which have been determined to require assessment pursuant to the Birds and Habitats Directives.

national legal or tax proposals (e.g. subsidies on fertilizer, water pricing).

Relevance from a biodiversity perspective: The performance of ecosystem services can be influenced by drivers of change. In the Millennium Ecosystem Assessment (MA) conceptual framework, a "driver" is any factor that changes an aspect of an ecosystem. A direct driver unequivocally influences ecosystem processes and can therefore be identified and measured to differing degrees of accuracy. These direct drivers of change can be identified and described in detail with the Impact Assessment Conceptual Framework. This framework underlies the description in situations 1, 2 and 3.

In the case of activities that have no obvious biophysical consequences it becomes more complex to define impacts on ecosystem services. The MA conceptual framework provides a structured way of addressing such situations. The activities exert their influence through indirect driver of change. These operate more diffusely, often by altering one of more direct drivers, and its influence is established by understanding its effect on a direct driver. Demographic, economic, socio-political, cultural and technological processes can be indirect drivers of change. Actors can have influence on some drivers (endogenous driver), but others may be beyond the control of a particular actor or decision-maker (exogenous drivers). (For more background information on the MA framework and the Impact Assessment framework, see the annex 2 to this chapter)

Screening criteria**:** An SEA is needed when the PPP is expected to significantly affect the way in which a society:

(i) consumes products derived from living organisms, or products that depend on ecosystem services for their production, or

(ii) occupies areas of land and water, or

(iii) exploits it's natural resources and ecosystem services.

Table X: When and how to address biodiversity in SEA - summary overview

Characteristics of PPP	*Example PPPs*	*When is biodiversity attention needed*	*How to address biodiversity issues*
Situation 1 Area known; activities undefined	Regional or nationale development plans	*Does the PPP influence:* Important ecosystem services, both protected (formal) or non-protected (stakeholder values) Areas with legal and/or international status; Environmental or nature policies (BAP, NEN, Natura 2000, etc.).	*Area focus* Systematic Biodiversity Planning for non-protected biodiversity. Ecosystem services mapping. Link ecosystem services to stakeholders. Invite stakeholders for consultation.
Situation 2 PPPs proposing biophysical and non-biophysical interventions with know biophysical consequences. Geographical demarcation unclear or large-scale.	Sectoral policies. Routing studies for large tracts of infrastructure.	*Does the PPP lead to:* Biophysical changes known to significantly affect ecosystem services (e.g land conversion, fragmentation, emissions, introductions, extraction, etc.) Non-biophysical changes with known biophysical consequences (e.g. relocation / migration of people, migrant labour, change in land-use practises, enhanced accessibility, marginalisation).	*Focus on direct drivers of change and potentially affected ecosystem* Identify drivers of change, i.e. biophysical changes known to affect biodiversity. Identify ecosystems sensitive to expected biophysical changes. Examples: - Sedimentation in mangroves & mudflats. - Soil stability in montane forests. - Fire and grazing in savannahs. - Nutrients in freshwater lakes. - Hydrology in wetlands. - Tidal prism in estuaries.
Situation 3 Intervention(s) and area(s) of influence are both known	Spatial planning Programme level location and routing alternatives. Technology alternatives	All of the above + detailed EIA-type of screening criteria (see EIA Guidelines)	*Knowledge of intervention and area of influence allows prediction of impacts on biodiversity aspects* Focus on drivers of change; , i.e. biophysical changes known to affect biodiversity. Identify affected biodiversity at appropriate level of detail (usually ecosystem). Define impacts on biodiversity aspects: i.e. changes in composition, or structure, or key processes. Describe affected ecosystems services and link services to stakeholders. Invite stakeholders for consultation.
Situation 4 PPPs without direct biophysical consequences; no or very large scale geographical demarcation.	Trade agreements Poverty reduction strategy papers Legal or tax proposals	Are there indirect drivers of change affecting the way in which a society produces or consumes goods, occupies land and water, or exploits ecosystem services?	*More research and case material needed !!* At present impacts are described in terms of quality of biodiversity (= species diversity) and surface area of biomes. MA methodology potentially valuable (further study) to identify linkages between indirect and direct drivers of change.

4.6 Is biodiversity attention required in SEA? Biodiversity-inclusive scoping

The start of the SEA process entails a scoping phase. In consultation with relevant stakeholders alternative actions are defined and issues to be assessed during the study are identified. As stated earlier, the reasons to start an SEA process may not be linked to biodiversity, but biodiversity often is influenced by policies, plans and programmes subject to SEA. There is ample reason to put emphasis on the scoping phase in order to identify biodiversity issues, but also to focus the study on relevant issues as to avoid unnecessary detailed studies.

In section 4.5 two important elements have been introduced which facilitate the identification of potential biodiversity impacts: (i) delineation of geographical boundaries, and (ii) distinctness of interventions. Four situations where described which determine the level of detail at which biodiversity issues can be addressed. In this section these elements will be further analysed. Before doing so one additional element is introduced, which is important in defining the way how biodiversity can be assessed, i.e. **extent of the study in relation to required level of detail**.

The required level of detail in a study depends on a variety of factors, such as the spatial and temporal scale of the study, the number of relevant issues to be studied, the severity of decision making implications, the available resources, etc. From a biodiversity perspective two scale aspects are important:

- The **extent** of the study, in terms of size of the area and duration of time under consideration. Physical, biological or social processes work on different scales in time and space. The extent of the study is not necessary limited by the geographical limits or by the time horizon of the policy or plan under assessment. It is important to know the relevant process to be studied and define the extent of the study accordingly.
- The **level of detail**, in ecology often referred to as **grain size**, of the study. An important determinant of the required level of detail is the level of decision making. Looking at the idealised tiered structure of SEA, in general it can be stated that a high level of decision making, such as policy decisions, usually requires low level of detail. Descending from policy to programmes and plans the required level of detail increases while in some cases (but definitely not always) the extent of the study area is reduced. The availability of information and financial resources, and the priorities expressed by stakeholders during the scoping process will further define the level of detail at which the study needs to be carried out.

Biodiversity has fine grain and large extent. In studying biodiversity fine grain has to be sacrificed for a large extent, or reciprocally, a requirement for fine-grain information often limits the extent of the study. Some practical examples show how the dilemma of large extent and fain grain of biodiversity can be addressed in different situations. They show that the biodiversity aspects composition, structure and key process provide a good means to focus the assessment (also see annex 4):

- **Limited extent with high level of detail, ánd focus on a key aspect of biodiversity (species composition) to reduce information requirements:** SEAs for district forestry plans in Nepal concentrated on the effects of forestry on forest composition and looked at species level information only. The extent of the study was limited, so species level information could be obtained. Furthermore, the dominant biophysical change caused by forestry activities primarily affects species composition, explaining the focus of the study.
- **Very large extent and low level of detail, with focus on key processes as determinants of impacts:** An SEA for a 600 km road in Bolivia concentrated on main ecosystems and hydrological processes (apart from social aspect not elaborated here). Road construction potentially affects the hydrology of the area. Because the road crosses wetlands of international importance, this key wetland process was the focus of study. The extent of the study area was of such magnitude that further detailed biodiversity analysis was not feasible.
- **Medium extent and sufficiently reduced level of detail by focussing on ecosystem structure:** An SEA for the siting of a nuclear power plant in India focussed on the connectivity of tiger

habitats. The highly endangered and strictly protected tiger triggered the study, but the study focussed on ecosystem structure, thus avoiding unnecessary detailed surveys.

- **Large extent, with high level of detail, but strongly focussed on one key process and the use of indicator species:** An SEA for a National Drinking Water Policy in the Netherlands concentrated on the main biophysical effects of water extraction (hydrological change). The extent of the study was large (the entire nation); defining a limited number of vegetation indicators for impact determination provided the required level of detail for policy decisions. (The availability of detailed vegetation inventories facilitated the use of computer technology to highlight areas sensitive to hydrological changes.)

Situation 1: Geographical delineation of the area influenced by the PPP is possible

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Focus: area for which the PPP applies

Summary of procedure:

- Describe ecosystems and map ecosystem services.
- Link ecosystem services to stakeholders and invite stakeholders for consultation.
- Apply systematic biodiversity planning for non-protected biodiversity.

Area oriented PPPs without precisely defined activities usually relate to regional or national development plans. Biodiversity can be described in terms of ecosystem services providing goods and services for the development and/or well-being of people and society. The maintenance of biodiversity is often emphasised as ecosystem service, described in terms of conservation status of ecosystem, habitats and species, possibly supported by legal protection mechanisms.

Annex 3 provides an elaborate list of potential ecosystem services provided by biodiversity which can serve an integrated type of SEA. From a more conservationist point of view, CBBIA (2004) presents a table of areas of high biodiversity importance (see Box).

Box: Areas of high biodiversity conservation importance (Source: CBBIA, 2004)

Areas of high biodiversity outside protected areas, may include those that:

- Act as a corridor, link-habitat or ‘stepping stone’.
- Act as a buffer or play an important part in maintaining environmental quality or critical ecosystem processes.
- Have important seasonal uses or are critical for migration.
- Support habitats, species populations, ecosystems that are vulnerable, threatened throughout their range and slow to recover.
- Support particularly large or continuous areas of relatively undisturbed or wild habitat.
- Support habitats that take a long time to develop characteristic biodiversity. Eg old-growth forest that has never previously been felled
- Support biodiversity for which mitigation is difficult or its effectiveness unproven.
- Are currently poor in biodiversity but have potential to improve, particularly where this may enhance availability of biodiversity resources for people

Two case studies have been analysed as examples of this category: In the first case biodiversity is not necessarily being rare or endangered. The case provides evidence of the economic and social sense it makes to maintain biodiversity for the services it provides. It shows a good example of mapping and monetisation of ecosystem services in a known geographical area as an input for informed decision making on priorities for interventions. It strongly emphasises the value of the concept of ecosystem services as a means to translate biodiversity information into the language of decision makers.

- An SEA has been carried out for the planning of open space in UMhlathuze, a rapidly developing and urbanising municipality in South Africa. River catchments provided an effective environmental entity for assessing synergistic impacts of urban development. A catchment is a functional unit as it constrains key energy and material flows; it also provides an easy unit of comparison. A strategic catchment assessment had to provide criteria for measures of protection and planning of development in non-developed lands. It accounted for the balance between supply of environmental goods and services provided by the natural environment and the demand for these goods and services by people. By using a pressure, state, response indicator model it was possible to make a status quo report of each catchment, indicating required management actions where needed. It furthermore calculated the economic benefits provided by 'free' ecosystem services at R 1.7 billion annually. Important benefits included water supply and regulation, flood and draught management, nutrient cycling and waste management. Monetisation of ecosystem services made decision makers react much more openly to the need for conservation measures, even when reputed for not listening to biodiversity arguments.

The second case provides a mechanism to focus on the need to conserve unique and important biodiversity in a situation of overwhelming presence of non-protected biodiversity, without jeopardizing the need of the country to develop.

- Since 2000 municipalities in South African have to prepare Spatial Development Frameworks and carry out associated SEAs. In two regions systematic biodiversity planning was applied to support this process in an attempt to improve effective consideration of biodiversity in Environmental Assessment. Most biodiversity in South Africa, including priority areas for conservation, does not fall within existing protected areas. Changing land use patterns have a major impact on biodiversity. Under such conditions sound SEA in land-use planning is critical to decision making. Systematic biodiversity planning aims at conserving a representative sample of species / habitats and key ecological and evolutionary processes. The focus on priority areas allows for recognition of competing land uses and development needs. It sets target for conservation and defines limits of acceptable change within which human impacts have to be kept. Although driven by conservation objectives, the process is very similar to SEA and outputs are easily integrated in the SEA process.

The combination of the two South African cases provides an excellent example of how to deal with both conservation of irreplaceable but non-protected biodiversity, and with sustainable use (ánd conservation) of biodiversity derived ecosystem services.

Situation 2: The PPP is concerned with concrete interventions with predictable biophysical consequences; intervention area is not defined or the area of influence is very large scale

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Focus: direct drivers of change and potentially affected ecosystems

Summary of procedure:

- Identify drivers of change, i.e. biophysical changes known to affect biodiversity.
- Identify ecosystems sensitive to expected biophysical changes.

The analysis of case studies revealed two different types of PPPs which, from a biodiversity point of view, can be treated similarly. The first category includes PPPs that have no predefined area of intervention, for example sectoral policies; the focus usually is national or at the level of states within nations. The second category includes PPPs of activities that can be linked to a geographical area, the size of which is at country or state scale rendering any detailed analysis of the area impossible.

Impacts on ecosystem services are defined in terms of a potential impact resulting from a biophysical change known to have significant impact on ecosystem services. This biophysical change can be a direct effect of the planned intervention or the result of social or economic consequences of interventions. At a lower level of planning these risks have to be projected on intervention areas in order to assess whether risks result in actual impacts.

Biophysical changes with potential significant impacts on ecosystem services:

- Land conversion: the existing habitat is completely removed and replaced by some form of land use. This driver of change is the most important cause of loss of biodiversity and related ecosystem services.
- Fragmentation by line-shaped infrastructure: roads, railways, canals, dikes, powerlines, etc. affects ecosystem structure by cutting habitats into smaller parts, leading to isolation of populations and genetic erosion. A similar effect is created by isolation through surrounding land conversion. Fragmentation is a serious reason for concern in areas where human presence is very noticeable and natural habitat already is fragmented.
- Extraction of living organisms usually is selective since only few species are of value. This leads to a change in species composition of ecosystems, potentially upsetting the entire system. Forestry and fisheries are common examples. Extraction of minerals, ores and water can significantly disturb the area where such extractions take place, often with significant downstream effects.
- Emissions and/or effluents: human activities can result in emissions or effluents affecting air (pollution), land (solid waste), water (liquid waste), or groundwater. Emissions from point sources (chimneys, drains, underground injections) as well as diffuse emission through for example agriculture or traffic, normally have a wide area of impact as the pollutants are carried away by wind, water or percolation. The range of potential impacts on biodiversity is very broad.
- Disturbance of ecosystem composition, structure or key processes: annex 3 contains an overview of how human activities can affect these aspect of biodiversity. Disturbance of composition includes introduction of non-indigenous species. Some case examples are provided throughout this document.

A PPP may also propose interventions that leads to significant social changes, known to lead to one of the above-mentioned biophysical changes. Examples are (non-exhaustive):

- Demographic changes due to permanent (settlement), temporary (temporary workers) or seasonal in-migration (tourism); these changes usually lead to a land occupancy (= land conversion), pollution and disturbance, especially in relatively undisturbed areas.
- Resettlement; is a special case of demographic change with similar biophysical consequences mentioned above.
- Conversion or diversification of economic activities: especially in economic sector related to land and water, diversification will lead to intensified land use and water use, including the use of pesticides and fertilizers, increased extraction of water, introduction of new crop varieties (and the consequent loss of traditional varieties). Change from subsistence farming to cash crops is an example.
- Conversion or diversification of land-use: similarly, any type of PPP aimed at enhancing the productivity of land-use will result in multiple biophysical changes. The type and mix of activities and the intensity of use are parameters. For example, the enhancement of extensive cattle raising includes conversion of natural grassland to managed pastures, application of fertilizers, genetic change of livestock, increased grazing density.
- Enhanced transport and (rural) accessibility; opening up of rural areas by improved means of transport will create an influx of people into formerly inaccessible area.
- Marginalisation and exclusion of (groups of) rural people: in many countries a class of landless rural poor are forced to put marginal lands into economic use for short term benefit. Such areas may include erosion sensitive soils, where the protective service provided by natural vegetation is destroyed by unsustainable farming practises. Deforestation and land

degradation are a result of such practises, created by non-equitable sharing of benefits derived from natural resources.

Two case studies have been analysed to illustrate this category. Both cases illustrate that even without a concrete geographical focus, ways exist to describe biodiversity impact in general terms, design mitigation measures, and provide guidance for the further study at lower level of assessment. The first case from the Netherlands illustrates a sectoral policy without predefined locations of interventions.

- The SEA for the Netherlands National Policy on Water Supply focussed on the most important biophysical effect of water extraction, i.e. a change in the hydrology of underground aquifers and surface waters. A major issue at national scale is the desiccation of various types of landscapes, predominantly old land-use types rich in biodiversity and highly valued for characteristic “Dutch” landscape features. Quantitative information on potential impacts of water extraction was deemed necessary. The national scale of the study forced the study team to focus on simple vegetation indications for hydrological changes. Combination of potential hydrological changes (modelled) with nationally available vegetation data provided a computational model which served the purpose of national decision making. Further elaboration of the policy into concrete plans and programmes requires further site-specific field observations to quantify potential impacts. The national Policy SEA identified potentially sensitive areas that require special attention.

The second case from Bolivia illustrates a programme with known area of influence, but it’s surface area measuring twice the surface of the Netherlands from the first example. It shows the importance of using SEA in a broad, integrated manner, including social and economic processes as the major driver of change in ecosystem services. The relatively pristine and untouched character of the area made such an approach essential in order to capture all relevant biodiversity impacts.

- An SEA for a 600 km road in Bolivia identified social and economic impacts as the main drivers of change associated to the road scheme. Economic development, creation of employment and immigration from the Andean highlands were considered main threats to ecosystem services as these would lead to increased land conversion. The SEA consequently included project area (road corridor) ánd area of direct and indirect influence. The extent of potential influence of the road is immense. Therefore, an identification of each affected ecosystem was impossible. In stead, and inventory of major types of ecosystems in the entire region was made, processes of key importance for the maintenance of these system were identified, and potential impacts induced by road development were identified. A hierarchy was designed, assigning types of ecosystem into categories with differing levels of protection. An extensive mitigation programme accompanies the road scheme, including assistance to management of national parks in the region and social support programmes.

Situation 3: PPP defines both area under influence and interventions

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Focus: Knowledge of interventions and area of influence allows relatively detailed assessment of potential impacts on aspects of biodiversity

Summary of procedure:

- Identify on drivers of change, i.e. biophysical changes known to affect biodiversity.
- Identify affected biodiversity at appropriate level of detail (usually ecosystem).
- Define impacts on biodiversity aspects: i.e. changes in composition, or structure, or key processes.
- Describe affected ecosystems services and link services to stakeholders.
- Invite stakeholders for consultation.

The majority of SEAs are carried for PPPs falling under this situation, which can be considered the first level above EIA. The fact of knowing both the area under influences and the interventions provides maximal possibilities to identify potential biodiversity-relayted impacts, to decide whether further attention to biodiversity is needed, and in what manner it can be studied.

Annex 2 provides the conceptual background of the impact assessment framework which can be applied in this situation. In this section the key steps from the framework will be illustrated with case examples to show how these issues have been dealt with in practise. For each step examples are provided. Case descriptions also have cross-references to other steps in the process, shown by the underlined words.

Direct drivers of change are those human interventions (activities) that lead to biophysical and social changes with known impacts on biodiversity and associated ecosystem services.

A case from Sweden takes biophysical changes resulting from urban development (= the driver of change) as the basis for identifying indicators to measure change in biodiversity. The case focuses on biodiversity conservation as important ecosystem service. The case has similarities to the systematic biodiversity planning case from South Africa; it shows that the concept can also be used for urban planning in a different setting. As a result non-protected biodiversity is taken into account.

- Urban planning of the area surrounding Stockholm (Sweden) requires strategic decision making on the model of urban expansion in a biodiversity rich environment. A biodiversity analysis at ecosystem level is carried out to support the SEA process. The analysis results in (i) operational target for biodiversity translating biodiversity policies into concrete objectives for the region, (ii) distinctive indicators for habitat change, (iii) reliable prediction methods, and (iv) sensible scenarios for future urban growth as a base for comparison. The indicators were linked to the major biophysical changes resulting from urban development affecting biodiversity: habitat loss, isolation/fragmentation, and disturbances.

Similarly biophysical changes were used as indicators to model the impacts of major interventions in river hydrology (= the driver of change) in the Netherlands. The case further illustrates the concept of ecosystem services and shows that ecosystem level information provides sufficient information for decision making.

- An SEA for a river management project along the river Meuse in the Netherlands had to study potential combinations of seemingly contradictory ecosystem services: flood control, shipping, and nature restoration. Reduction of peak flows in the river for safety was the main objective. The SEA took a historical perspective and portrayed major services of the ecosystems throughout the ages – biodiversity has been managed and exploited to such an extent that the resulting ecosystems depend on human management to maintain their appreciated features. Based on this information four alternatives were developed. Water depth, flood duration and groundwater level were considered key biophysical changes affecting biodiversity. These were modelled in a computational model and linked to the requirements of different ‘ecotypes’ (= small-scale ecosystems). It provided sufficient information to compare alternatives, although further field observation are required for detailed intervention planning.

The availability of biodiversity inventory data greatly enhances SEA studies by allowing computational models to link computed biophysical changes to indicator species or ecosystemss. As the distribution of these is known, effects of the interventions can be estimated at a level of detail which is sufficient for strategic decision making.

Aspects of biodiversity: impacts on biodiversity can best be described in terms of changes in composition (what is there), or changes in structure (how is it organised in time and space), or changes in key processes (what physical, biological or human processes govern creation and maintenance of ecosystems).

A case from Nepal shows that prior knowledge on how a biophysical changes affects a specific aspect of biodiversity provides a means to focus an SEA study. In this case forestry (= intervention) leads to selective removal of trees (biophysical change), affecting species composition.

- Plan level SEAs were carried out in Nepal to assess the environmental impacts of districts forestry plans. Forestry practises were considered to impact on biodiversity by changing the species composition of forests; this consequently was the focus of the study. The SEA resulted in recommendations on how to include conservation principles in forestry activities.

From India two examples were provided where the need for an SEA was triggered by protected species, but where the SEA study focussed on ecosystem and foodweb structure to provide relevant and sufficient information.

- SEA was used in India as a diagnostic tool to assess siting alternatives of a nuclear power facility. The facility was partially projected on one of India's prominent tiger reserves. The facility also affected traditional land use practises. Regulations limited the study area to a 25 km radius. Within this radius protected areas and ecologically sensitive areas were defined. The study focused on contiguity of habitats for endangered species (such as tiger, leopard, Indian wolf and others)and the area needed for predators to have sufficient stock of prey animals. In other words, the study focussed on ecosystem structure: the spatial structure of habitat and food web structure.
- An SEA approach was followed in India to review an EIA of a planned dam and irrigation scheme which resulted in deadlock. The deadlock resulted from a lack of attention to wildlife migration routes (including tigers). The SEA aimed at enhancement of conservation planning and mediation to steer environmental decision making. Again vital habitat links (corridors) and foodweb structure were the focus of study. The creation of a new reservoir provided important new habitats; the design of a canal created fragmentation of major habitats. Redesign of a new migration corridor upstream of the canal mitigated this problem, and the SEA resulted in renewed decision making.

Changes in key processes as a means to identify impact on ecosystem services appear in a number of cases throughout the text.

Ecosystem services. Translating biodiversity into ecosystem services is an effective means to make biodiversity tangible in impact assessment. Services represent ecological, social and economic values for society and can consequently be linked to stakeholders. Stakeholders can speak on behalf of biodiversity and can consequently be involved in an SEA process. Maintenance of biodiversity (or nature conservation) is an important ecosystem service.

A case from the U.K. shows that by taking an ecosystem services approach with active involvement of stakeholders, an important contribution to the definition of viable SEA alternatives was made.

- The availability of Biodiversity Action Plans (B.A.P.s) and Species Action Plans (S.A.P.s) provided biodiversity objectives for an SEA on a local flood management strategy in the UK. Within the wetland ecosystem, priority habitats and priority species have been defined in the B.A.P. Furthermore, ecosystem services were considered an important economic asset of the region, with biodiversity based tourism as most important sector. Opportunities to use wetlands for flood attenuation provided additional important benefits. Flood management was considered to be a key driver of change, as flooding is a key ecological process in wetlands. The study area was defined on the basis of likely limits of impacts. For the assessment it was considered appropriate to identify risks and the main ecological processes likely to affect outcomes for biodiversity in relation to objectives for the area. Public participation was action-oriented, focussed on identifying preferred changes to achieve outcomes compatible with stakeholder interests; local knowledge was an important source of information. Biodiversity specialists were able to provide effective flood control alternatives that were also beneficial for biodiversity (making use of ecosystem services).

A case from the Waddensea in the Netherlands shows that natural ecosystems provide multiple services. Exploitation of one service leads to potential impacts on others when key ecosystem processed are affected. Stakeholder involvement reoriented the SEA study to be more focussed on these key processes, in stead of looking at the exploited ecosystem service only.

- The Netherlands national policy on large scale extraction of shells in marine environment required an SEA. Shell mining also takes place in protected areas, representing important international ecosystem services for the maintenance of pathways of migratory birds and breeding grounds of North Sea fish, tourism, etc. Focus of the permitting procedure was on whether the ecosystem service was not overexploited; in other word the natural regeneration of shell deposits was studied in relation to exploitation pressure. However, the mining process itself also influences key ecological processes essential to other ecosystem services. Bottom morphology and related bottom life were consequently included in the SEA study. Stakeholder contributions highlighted the lack of knowledge on the function of shells and shell banks in the ecosystems. As a result more alternatives were included in the study. The study concluded that natural re-growth fully compensates mining; it was concluded however that ecological processes should define mining conditions. Potential mining locations were ranked according these conditions. In small parts of the area the precautionary principle was applied because too little was known of the function of shell banks and mining was prohibited. An interesting equity discussion erupted. Shell mining was a monopolised business; the SEA process triggered a discussion on public tender procedures for other interested operators. This request was granted.

The cases presented in this guidelines document are a selective sample of good practise cases. In reality, many aspects of biodiversity will often go unnoticed in SEA. Even with this selective, biodiversity friendly sample of cases, it has become clear that the concept of ecosystem services does not yet receive wide recognition. As stated earlier, many of the ecosystem services are considered to be the responsibility of a sector department (fisheries, irrigation department, public work department, etc.) that has no obvious linkage with biodiversity issues and usually does not consider it's activities in an integrated, cross-sectoral manner. This explains that many ecosystem services go unnoticed, thus losing an opportunity to describe the actual values of biodiversity. (An irrigation department will not automatically see the downstream fisheries impacts of its measures; a public works department considers flood storage by wetlands as sub-optimal and designs flood storage basins; a forestry department is not inclined to change forestry practises and reduce revenues in order to enhance tourism or leisure activities; etc.).

Levels of biodiversity. Three levels are distinguished (genetic, species, ecosystems) but in general, the ecosystem level is the most suitable level to address biodiversity in SEA, as most cases above have shown. Even in cases where the trigger to start an SEA was at species level (protected tigers in India), the studies focussed on ecosystem structure. Similarly, the Nepal case focuses on species composition only and does not go into further detail of individual species. In other studies individual species only serve the purpose of being an indicator for changes in key ecosystem processes. The large extent of study areas, the limited resources available for SEA, and a lesser level of detail required for strategic decision making explain this focus on more generic biodiversity issues and a 'loss' of focus on species level information.

However, situations exist with a need to address lower levels. A case from U.K. shows that for local level plans it may be needed and possible that the SEA looks at species level information. The limited extent of the study area and the presence of many protected species in non-protected areas required detailed analysis of these species. Yet, the study focussed on indicator species for each biophysical change in order to reduce data collection effort.

- In the UK A Local Transport Plan requires an SEA. In an area renown for it's biodiversity, the SEA focussed on species and their habitats. Roads are considered to lead to a number biophysical changes: barrier effects (for example cutting of routes to foraging areas of bats), road mortality, emission into air and water, hydrological changes, and fragmentation of habitats. For each effect a 'focal species' was used as an indicator. Many protected species rely on unprotected countryside and species-level attention. Furthermore, the study included alternatives that would minimise impacts on priority habitat as listed in the Biodiversity Action Plan.

Legal protection - a word of caution. A case form the Netherlands shows the far-reaching influence of a formal system of protected areas ánd a policy for the enhancement of this system. It forces spatial planners to take biodiversity into account and it defines the setting for SEA of such plans. Similarly formal policies trigger biodiversity attention within SEA through Biodiversity Action Plans in the UK.

- Analysis of four spatial planning SEAs at national, provincial and municipal level in the Netherlands revealed the overwhelming importance of the National Ecological Network (NEN, predecessor to and part of the European Nature 2000 network of protected areas). The NEN is intended to create a continuous network of <u>protected areas</u>; the area has been formally defined, but in broad terms. All spatial plans coinciding with the NEN have to include nature restoration measures in order to comply with the NEN policy and SEAs strictly assess proposed alternatives on this aspect. The focus consequently is on <u>ecosystems</u>; species level diversity does not play a role as the NEN includes species-related protected areas (EU birds & habitat directives). Further biodiversity attention is focussed on restoration of <u>key hydrological processes</u> in existing protected areas. Since most activities focus on enhancing the quality of existing nature and increasing the surface area of protected area, non-protected biodiversity is lost out of sight.

The down-side of the strong Netherlands policy on the National Ecological Network is that non-protected biodiversity and ecosystem services other than maintenance of biodiversity get out of focus in spatial planning but also even in the SEA of such plans. SEA is supposed to picture the impacts of plans on protected and non-protected biodiversity. The built-in argument is that if biodiversity is not protected it probably is not worth taking into account and it consequently does not appear in the SEA. The UMhlathuze strategic catchment assessment (South Africa) has already shown that non-protected and non-threatened biodiversity still represents highly valued ecosystem services.

An important observation from a number of cases above is that public participation may lead to a broader perspective of biodiversity resulting in formulation of different alternatives. The UK flood management case and the Dutch shell mining case both show that public participation resulted in enhanced studies, including a significant contribution of viable alternatives. Public participation may also be the key to biodiversity-inclusive SEA in cases where this is not triggered by objectives of the study or by formal regulations.

Situation 4: PPP is concerned with interventions without direct biophysical consequences; geographical demarcation is unclear or extremely large-scale (countries, regions)

The EU applies sustainability impact assessments to it's trade agreements (differing from 'classical' SEA because of it's inclusion of social and economic impacts). The approach is to project effects of trade measures on consumer and producer behaviour, and hence on production systems. Baseline conditions, trends and characteristics of the production and socio-economic systems determine whether indirect consequences will actually affect biodiversity. Biodiversity impact is described in very broad terms, mainly as changes in quantity (surface area) and quality of biodiversity (species richness). Grouping of countries with relatively similar characteristics provides some further detail. Per group of countries a case study country is studied more in-depth.

The difficulty in the identification of biodiversity-related impact lies in the definition of impact mechanism. The EU sustainability impact assessment of WTO trade agreements on agriculture and forest products has been analysed as a case example. This SEA works with a combination of economic modelling studies, empirical evidence from literature, case study analysis and causal chain analysis. Impacts are described only in terms of change in quality and quantity.

By addressing specific sectors in economy it was possible to broadly define the ecosystems under pressure, such as forests in the forestry sector, without any specific indication of the location of these ecosystems. The available case study, however, predicted that the major impacts on forests (and other relatively untouched ecosystems) can be expected from trade liberalisation in agriculture. The need for agricultural land is a much stronger driving force leading to forest conversion than the forestry sector itself.

The approach is very similar to the Millennium Ecosystem Assessment (MA) approach, although both approaches have developed separately. The present scenario development under the MA may provide relevant input in the trade impact assessment process as it provides further elaboration of the linkages between indirect and direct drivers of change in biodiversity. Presently many studies under the MA are undergoing review and will become available soon. Further exploration of this material is recommended

Box: when NOT to focus on biodiversity

(All reviewers: please give this box a good thought and add anything you like. It is important, but since we focussed on cases **with** biodiversity, we haven't seen all the cases in which biodiversity was scoped out of the assessment and on what grounds)..

The guidelines have provided clues how to identify potential impacts on biodiversity through the identification of biophysical changes with know impacts on biodiversity composition, structure or key processes. Knowledge on the area where these impacts occur further provides information on affected ecosystem services, which allows for identification of stakeholders and a complete representation of biodiversity in the SEA process.

A question of great concern to all those involved in impact assessment is when NOT to further study certain issues. Impact assessment can only be effective if it focuses on real issues of societal concern; impact assessment should not end up in endless data gathering exercises with little added value to decision making.

Each human activity leads to biophysical changes (by our very existence we continuously change our environment), but not all biophysical changes lead to relevant biodiversity impacts. Approaches which may be of help in focussing biodiversity related assessment to the real issues are:

- **Stakeholder involvement** – if there is no stakeholder interested in speaking on behalf of an issue, there is no issue (taken that all potential stakeholders are involve din the process).
- **Limits of potential impact** – (Jo it appeared in your case; van you add something)
- **Threshold of potential concern** – in a number of countries this concept is successfully applied in biodiversity management (Reviewers from RSA: could you expand a bit on this issue?!?!) I know it is used in park management in South Africa)
- *Anthing else?*

………….

- **ANNEX TO SEA GUIDELINES**

Annex 1: General information on SEA

The advantages of SEA

SEA meets the need for more holistic, integrated and balanced strategic decision making as called for in many initiatives, including the 2002 World Summit on Sustainable Development. Also, SEA serves Millennium Development Goal 7 to 'integrate the principles of sustainable development into country policies and programmes and helps reverse the loss of environmental resources.'

The final objective of SEA is to contribute to sustainable development, poverty reduction and good governance. Advantages of SEA to decision makers are:

- Enhanced credibility of their decisions in the eyes of stakeholders, leading to swifter implementation;
- Improved economic efficiency because potential environmental stumbling blocks for economic development are better known;
- The broader approach of SEA keeps the process aware of promising alternatives
- A better understanding of the cumulative impact of a series of smaller projects, thus preventing costly and unnecessary mistakes;
- Better insight in the trade-offs between environmental, economic and social issues, enhancing the chance of finding win-win options;
- More knowledge of the social feasibility of a decision, thus avoiding resistance from unhappy local groups, bad image for planners, useless mitigating measures and simply missing the bigger picture;
- Easier assessment at the project level because strategic discussions, e.g. on locations, have already been brought to a conclusion.

The characteristics of EIA and SEA are different.

Characteristics of SEA and EIA

SEA	**EIA**
takes place at earlier stages of the decision making cycle	takes place at the end of the decision making cycle
pro-active approach to help development of proposals	Reactive approach to development of proposals
considers broad range of potential alternatives	considers limited number of feasible alternatives
early warning of cumulative effects	limited review of cumulative effects
emphasis on meeting objectives and maintaining systems	emphasis on mitigating and minimising impacts
broader perspective and lower level of detail to provide a vision and overall framework	narrower perspective and higher level of detail
multistage process, continuing and iterative, overlapping components	well-defined process, clear beginning and end
focuses on sustainability agenda and sources of environmental deterioration	focuses on standard agenda and symptoms of environmental deterioration

The key steps of SEA resemble those in EIA. However, the actual tasks during those steps may be quite different.

Steps in SEA and EIA

	SEA	**EIA**
Screening	Mostly decided case by case	Projects requiring EA are often listed
Scoping	Combination of political agenda, stakeholder discussion and expert judgement	Combination of local issues and technical checklists
Public partici-pation	Focus on representative bodies	Often include general public
Assessment	More qualitative (expert judgement)	More quantitative
Quality review	Both quality of information and stakeholder process	Focus on quality of information
Decision making	Comparison of alternatives against policy objectives	Comparison against norms and standards
Monitoring	Focus on plan implementation	Focus on measuring actual impacts

IAIA Performance Criteria on SEA

A good-quality Strategic Environmental Assessment (SEA) process informs planners, decision makers and affected public on the sustainability of strategic decisions, facilitates the search for the best alternative and ensures a democratic decision making process. This enhances the credibility of decisions and leads to more cost- and time-effective EA at the project level. For this purpose, a good-quality SEA process:

Is integrated

- Ensures an appropriate environmental assessment of all strategic decisions relevant for the achievement of sustainable development.
- Addresses the interrelationships of biophysical, social and economic aspects.
- Is tiered to policies in relevant sectors and (transboundary) regions and, where appropriate, to project EIA and decision making.

Is sustainability-led

- Facilitates identification of development options and alternative proposals that are more sustainable.

Is focused

- Provides sufficient, reliable and usable information for development planning and decision making.
- Concentrates on key issues of sustainable development.
- Is customized to the characteristics of the decision making process.
- Is cost- and time-effective.

Is accountable

- Is the responsibility of the leading agencies for the strategic decision to be taken.
- Is carried out with professionalism, rigor, fairness, impartiality and balance.
- Is subject to independent checks and verification.

- Documents and justifies how sustainability issues were taken into account in decision making.

Is participative

- Informs and involves interested and affected public and government bodies throughout the decision making process.
- Explicitly addresses their inputs and concerns in documentation and decision making.
- Has clear, easily-understood information requirements and ensures sufficient access to all relevant information.

Is iterative

- Ensures availability of the assessment results early enough to influence the decision making process and inspire future planning.
- Provides sufficient information on the actual impacts of implementing a strategic decision, to judge whether this decision should be amended and to provide a basis for future decisions.

Direct drivers of change: impact assessment framework

The conceptual framework behind the Guidelines on Biodiversity in Impact Assessment, first endorsed by the CBD in 2002, and further elaborated in this document, is developed under auspices of the International Association for Impact Assessment (see figure x adapted from Slootweg & Kolhoff, 2003). The framework has been developed for concrete interventions in the biophysical and social environment and provides a framework to integrate biophysical and social processes in impact assessment.

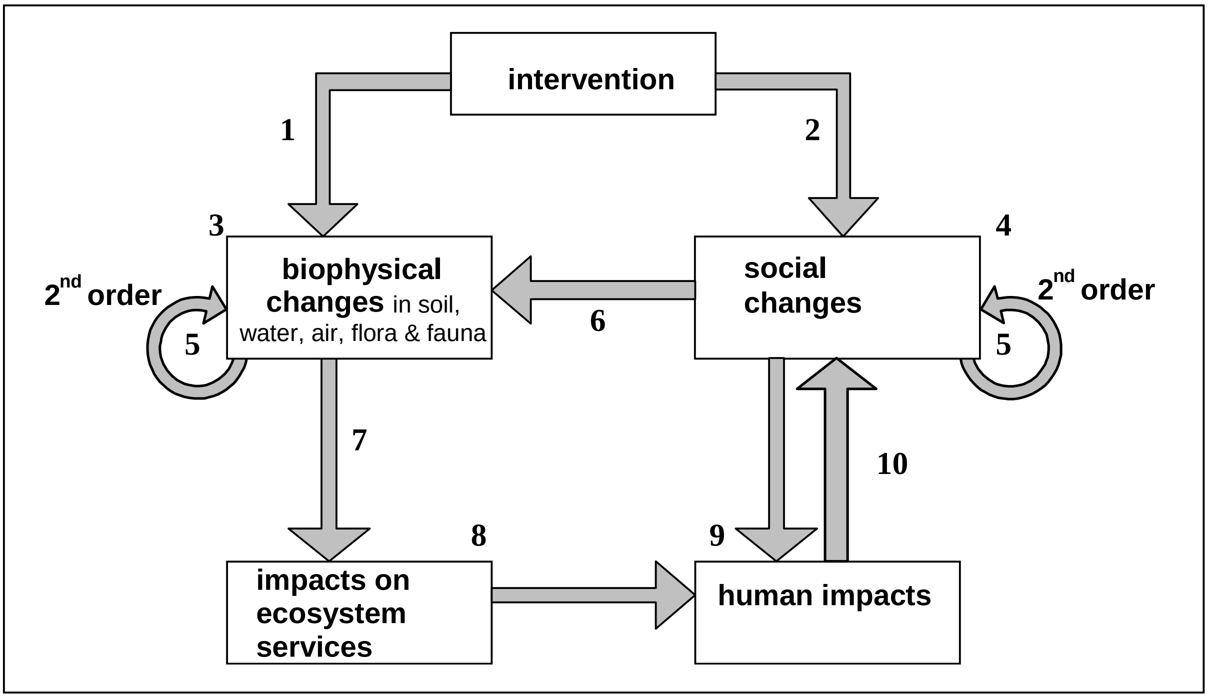

Figure x: impact assessment framework

Physical (1) and social (and economic) (2) interventions lead to biophysical (3) and social (4) changes, each of these potentially leading to higher order changes (5). Some social changes may lead to biophysical changes (6). Within their range of influence and depending on the type of ecosystem under influence (7), biophysical changes may influence different aspects of biodiversity. If these impacts are significant this has an impact on the ecosystem services provided by biodiversity (8). Impacts on ecosystem services will lead to a change in the valuation of these services by various stakeholders in society (9). People may respond to these changes in the value of ecosystem services and act accordingly (10), thus leading to new social changes.

The loops in this framework of thinking can in principle be endless; good participatory scoping, applying best available scientific and local knowledge, has to result in the most relevant impacts and associated cause effects chains, that need to be studied / managed.

Indirect drivers of change: Millennium Ecosystem Assessment framework

The Millennium Ecosystem Assessment (MA) is a four-year international work programme designed to meet the needs of decision-makers for scientific information on the links between ecosystem change and human well-being. It was launched by UN SG Kofi Annan in June 2001. Leading scientists from over 100 nations are conduction the MA.

The first product of the MA is a conceptual framework providing the thinking behind all ongoing work. Relevant features of the framework are explained below (see figure x; published in MA, 2003). The MA conceptual framework is fully consistent with the CBD Ecosystem Approach (CBD 1999 & 2004).

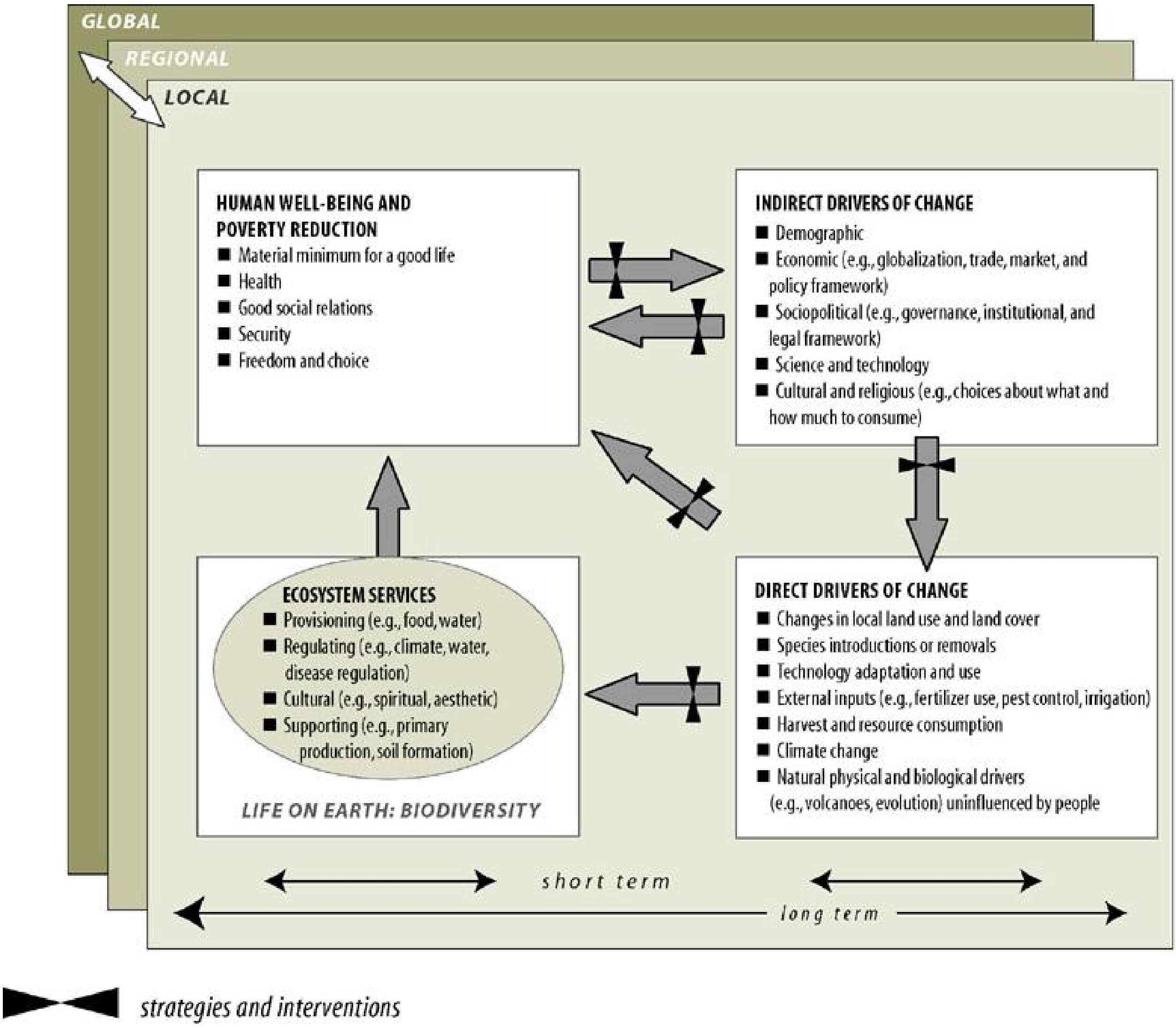

Figure x: Conceptual framework used by the Millennium Ecosystem Assessment.

An important feature of the MA is the translation of biodiversity into **ecosystem services**, which contribute to human well-being and poverty reduction. Humanity is ultimately fully dependent on the flow of ecosystem services. The degradation of ecosystems place a growing burden on human well-being and economic development. Ecosystem services are (i) provisioning services (harvestable goods such as fish, timber, bush meat, fruits, genetic material), (ii) regulating services responsible for maintaining natural processes and dynamics (e.g. water purification, biological control mechanisms, carbon sequestration, pollination of commercially valuable crops, etc.), (iii) cultural services providing a source of artistic, aesthetic, spiritual, religious, recreational or scientific enrichment, or nonmaterial benefits, and (iv) supporting services necessary for the production of all other ecosystem services (e.g. soil formation, nutrients cycling and primary production). An ecosystem service is described in terms of stock, flow and resilience.

The performance of ecosystem services can be influenced by **drivers of change**. In the MA, a “driver” is any factor that changes an aspect of an ecosystem. A **direct driver** unequivocally influences ecosystem processes and can therefore be identified and measured to differing degrees of accuracy. An **indirect driver** operates more diffusely, often by altering one of more direct drivers, and its influence is established by understanding its effect on a direct driver. Demographic, economic, socio-political, cultural and technological processes can be indirect drivers of change. Actors can have influence on some drivers (**endogenous driver**), but others may be beyond the control of a particular actor or decision-maker (**exogenous drivers**).

The **geographical scale** at which strategies and interventions can affect a driver of change varies from local to global, and may work at widely different **time scales**. Consequently, the **organisational scale** at which to best address a driver of change needs to be assessed for each situation.

Links between MA and IA frameworks

The Impact Assessment framework provides a framework to describe direct drivers of change that result from human interventions. It establishes linkages between biophysical and social changes and provides insight in how interventions may lead to impacts, either through biophysical interventions or through social interventions. It makes a clear distinction between transitional biophysical and social changes (effect of human interventions that can be measured, modelled, predicted) and impacts that are defined by the local context (affected ecosystems, including associated stakeholders). It is a strong conceptual basis for impact assessment at levels where interventions in the social and biophysical environment are known, at project level but also at the level of strategic assessment for regional or sectoral plans.

The Millennium Assessment is not developed for such types of impact assessment, but moreover aims at providing information for natural resources management polices. Its concepts are largely similar to the Impact Assessment framework, but better serves the highest level of strategic assessment where interventions are not precisely known. The notion of indirect drivers of change, or in other words, diffuse societal processes that influence or even govern direct drivers of change, provides a strong concept to coherently describe chains of cause and effect at (strategic) policy level.

N.B: The MA framework largely overlooks that social changes can also be considered direct drivers of change. For example, the creation of employment in a relatively uninhabited area will attract migrants that settle in the vicinity of the facility, occupying formerly uninhabited areas. There is nothing diffuse to this as it is a planned activity with predictable consequences.

References:

Millennium Ecosystem Assessment (2003). *Ecosystems and Human Well-being: A Framework for Assessment.* Island Press. (http://www.millenniumassessment.org/ en/products.ehwb.aspx)

Slootweg, R. & A. Kolhoff (2003). A generic approach to integrate biodiversity considerations in screening and scoping for EIA. Environmental Impact Assessment Review 23: 657-681.

ANNEX 3: INDICATIVE LIST OF ECOSYSTEM SERVICES

Provisioning services: harvestable goods
Natural production:
- timber
- firewood
- grasses (construction and artisanal use)
- fodder & manure
- harvestable peat
- secondary (minor) products
- harvestable bush meat
- fish and shellfish
- drinking water supply
- supply of water for irrigation and industry
- water supply for hydroelectricity
- supply of surface water for other landscapes
- supply of groundwater for other landscapes
- genetic material

Nature-based human production
- crop productivity
- tree plantations productivity
- managed forest productivity
- rangeland/livestock productivity
- aquaculture productivity (freshwater)
- mariculture productivity (brackish/saltwater)

Regulating services responsible for maintaining natural processes and dynamics
Land-based regulating services
- decomposition of organic material
- natural desalinization of soils
- development / prevention of acid sulphate soils
- biological control mechanisms
- pollination of crops
- seasonal cleansing of soils
- soil water storage capacity
- coastal protection against floods
- coastal stabilization (against accretion / erosion)
- soil protection
- suitability for human settlement
- suitability for leisure and tourism activities
- suitability for nature conservation
- suitability for infrastructure

Water related regulating services
- water filtering
- dilution of pollutants
- discharge of pollutants
- flushing / cleansing
- bio-chemical/physical purification of water
- storage of pollutants
- flow regulation for flood control
- river base flow regulation
- water storage capacity
- ground water recharge capacity
- regulation of water balance
- sedimentation / retention capacity
- protection against water erosion
- protection against wave action
- prevention of saline groundwater intrusion
- prevention of saline surface-water intrusion
- transmission of diseases
- suitability for navigation
- suitability for leisure and tourism activities
- suitability for nature conservation

Air-related regulating services
- filtering of air
- carry off by air to other areas
- photo-chemical air processing (smog)
- wind breaks
- transmission of diseases
- carbon sequestration

Biodiversity-related regulating services
- maintenance of genetic, species and ecosystem composition
- maintenance of ecosystem structure
- maintenance of key ecosystem processes for creating or maintaining biological diversity

Cultural services providing a source of artistic, aesthetic, spiritual, religious, recreational or scientific enrichment, or nonmaterial benefits.

Supporting services necessary for the production of all other ecosystem services
- soil formation,
- nutrients cycling
- primary production.
- evolutionary processes

ANNEX 4: ASPECT OF BIODIVERSITY: COMPOSITION, STRUCTURE, AND KEY PROCESSES

Composition	**Influenced by:**
Minimal viable population of: (a) legally protected varieties/cultivars/breeds of cultivated plants and/or domesticated animals and their relatives, genes or genomes of social, scientific and economic importance; (b) legally protected species; (c) migratory birds, migratory fish, species protected by CITES; (d) non-legally protected, but threatened species; species which are important in local livelihoods and cultures.	- selective removal of one or a few species by fisheries, forestry, hunting, collecting of plants (including living botanical and zoological resources); - fragmentation of their habitats leading to reproductive isolation; - introducing living modified organisms that may transfer transgenes to varieties / cultivars / breeds of cultivated plants and/or domesticated animals and their relatives; - disturbance or pollution; - habitat alteration or reduction; - introduction of (non-endemic) predators, competitors or parasites of protected species.
Structure	**Influenced by:**
<u>Changes in spatial or temporal structure</u>, at the scale of relevant areas, such as: (a) legally protected areas; (b) areas providing important ecosystem services, such as (i) maintaining high diversity (hot spots), large numbers of endemic or threatened species, required by migratory species; (ii) services of social, economic, cultural or scientific importance; (iii) or supporting services associated with key evolutionary or other biological processes.	Effects of human activities that work on a similar (or larger) scale as the area under consideration. For example, by emissions into the area, diversion of surface water that flows through the area, extraction of groundwater in a shared aquifer, disturbance by noise or lights, pollution through air.etc.
<u>Foodweb structure and interactions</u>. Species or groups of species perform certain roles in the foodweb (functional groups); changes in species composition may not necessarily lead to changes in the foodweb as long as roles are taken over by other species.	All influences mentioned with *composition* may lead to changes in the foodweb, but only when an entire role (or functional group) is affected. Specialised ecological knowledge is required.
<u>Presence of keystone species</u>: these are often species that singularly represent a given functional type (or role) in the foodweb.	All influences mentioned with composition that work directly on keystone species. This is a relatively new, but rapidly developing field of ecological knowledge. Examples are: • sea otters and kelp forest • elephants and African savannah • starfish in intertidal zones • salmon in temperate rainforest • tiger shark in some marine ecosystems • beaver in some freshwater habitats • black-tailed prairie dogs and prairie

Key processes (some examples only)	**Influenced by**
Sedimentation patterns (sediment transport, sedimentation, and accretion) in intertidal systems (mangroves, mudflats, seagrass beds)	- reduced sediment supply by damming of rivers; interruption of littoral drift by seaward structures
Plant-animal dependency for pollination, seed dispersal, nutrient cycling in tropical rainforests	- selective removal of species by logging, collecting or hunting
Soil surface stability and soil processes in montane forests	- imprudent logging leads to increased erosion and loss of top soil
Nutrient cycling by invertebrates and fungi in deciduous forests	- soil and groundwater acidity by use of agrochemicals.
Plant available moisture in non-forested, steeply sloping mountains	- overgrazing and soil compaction lead to reduced available soil moisture
Fire and grazing by herbivorous mammals in savannahs	- cattle ranching practises
Available nutrients and sunlight penetration in freshwater lakes	- inflow of fertilizers and activities leading to increased turbidity of water (dredging, emissions)
Hydrological regime in floodplains, flooded forests and tidal wetlands	- changes in river hydrology or tidal rhythm by hydraulic infrastructure or water diversions
Permanently waterlogged conditions in peat swamps and acid-sulphate soils	- drainage leads to destruction of vegetation (and peat formation process), oxidisation of peat layers and subsequent soil subsidence; acid sulphate soils rapidly degrade when oxidised
Evaporation surplus in saline / alkaline lakes	- outfall of drainage water into these lakes changes the water balance
Tidal prism and salt/freshwater balance in estuaries	- infrastructure creating blockages to tidal influence; changes in river hydrology change the salt balance in estuaries.
Hydrological processes like vertical convection, currents and drifts, and the transverse circulation in coastal seas	- coastal infrastructure, dredging.