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POSSIBLE INDICATORS FOR WATER AND WATER-RELATED ECOSYSTEM SERVICES FOR THE STRATEGIC PLAN FOR BIODIVERSITY 2011-2020 AND THE AICHI BIODIVERSITY TARGETS[1]

Information note by the Executive Secretary

EXECUTIVE SUMMARY

An assessment was made of some relevant indicators for water and water-related and dependent ecosystem services in the context of the monitoring framework for the Strategic Plan for Biodiversity 2011-2020 and its Aichi Biodiversity Targets. Guidance on the objectives of an indicators framework is derived from relevant decisions of the Conference of the Parties to the Convention on Biological Diversity at it's tenth meeting of the Conference of the Parties in particular X/2 (Strategic Plan for Biodiversity 2011-2020), X/7 (Goals, targets and indicators) and, regarding water, X/28 (Inland waters). Whilst the key requirement is a monitoring framework for the targets, the Strategic Plan is more than just its targets and in particular it lays down the context for the targets, the overall objectives and how to achieve them. Particular note is made in these decisions of the need for mainstreaming biodiversity, engaging with the broadest range of interests and, in particular, with regards to development and human well-being. The tenth meeting of the Conference of the Parties also, *inter alia*, requested an emphasis on monitoring the current gap regarding ecosystem services and using, where feasible, indicators already in use by other processes. These decisions provide or imply criteria for indicator choice. They call for particular attention to the messaging power of indicators and resonance with broader stakeholders including their ability to open up the significant storylines, noting that these relate largely to human well-being, and to address ecosystem services with high social and economic values. Water-related services score very highly in these regards due to the importance of water to development.

The Aichi Biodiversity Targets can be grouped into those relating to enabling conditions, direct actions and the desired state. The latter is encapsulated largely by target 14 (Maintain essential ecosystem

* UNEP/CBD/SBSTTA/15/1/Rev.1

[1] This note was originally provided in May 2011 as an information note for the Ad Hoc Technical Expert Group Meeting on Indicators for the Strategic Plan for Biodiversity 2011-2020, High Wycombe, United Kingdom, 20-24 June 2011 (UNEP/CBD/AHTEG-SP-Ind/INF/3).

services) which is closely aligned to the vision of the Strategic Plan. Other targets dealing with ecosystem services directly are targets 6 (Fisheries), 7 (Agriculture, aquaculture and forestry sustained), 15 (Carbon stocks and climate change mitigation and adaptation) and, partly, target 11 (protected areas). All of these are technically in whole or in part subsets of target 14. Outcomes with regards to target 14 (and other targets in terms of measuring ecosystem services directly) are the key test of whether the Strategic Plan is achieving its vision. The subject of indicators for this area is therefore particularly important.

Despite the emphasis in the Strategic Plan on human well-being (e.g., the vision and strategic goal D), only target 14 makes explicit reference to this. Notably, none of the current set of indicators in use or proposed (so far in the development of the indicator framework),[2] excepting one deemed not feasible, directly address human development. This is in marked contrast to, for example, the United Nations Convention to Combat Desertification (UNCCD), where human development indicators are central. For the Convention on Biological Diversity the argument is that by maintaining biodiversity and ecosystem services, etc., human well-being is addressed. But the current disconnect between the targets/indicators and people's main interest (well-being) in most cases requires storylines to be reconstructed, at least for most audiences. One approach to address this need would be to explore human development indicators for the vision of the Strategic Plan, much along the lines of the UNCCD, but this was not requested by the Conference of the Parties. The second approach is to adopt, where feasible, indicators for the targets that directly reconnect people and biodiversity. The search for such indicators had high priority in the work undertaken for this note.

Capturing the water dimension of ecosystem services involves two related considerations. The first is that water (meaning freshwater) is required to support all terrestrial ecosystem functioning, and wetlands, and indeed is highly influential on a large part of coastal ecosystem functioning. Changes in its availability (and quality) affect all ecosystem service delivery (with the exception of those delivered by oceans). This is the primary reason why water has “paramount importance”, not only for target 14, but for all of them. The second is that sustaining water in appropriate quantities and quality are ecosystem services in themselves (primarily water provisioning and regulation). Water is probably the most important natural resource required directly by people: the second reason for its “paramount importance”. Practically any indicator related to water is relevant and there are very many of these available. This note, however, focuses on those with the most direct and obvious links with ecosystems and biodiversity and where relatively easily derived and priority biodiversity storylines can be developed.

Ecosystems underpin the water cycle, which involves interconnected components including precipitation, liquid surface water, freshwater ice, groundwater, soil moisture and humidity. An ideal indicator set would capture all of these components in temporal, spatial, ecosystem and socio-economic contexts. This note includes some attention to all these dimensions (except ice).

This work concluded very early that starting the search for indicators with the targets as the entry point was problematic. It was much easier, and probably more relevant, to seek the headline stories, explore indicators, then fit them to targets. This is partly due to the cross-cutting nature of water (and probably ecosystem services in general) and therefore many of the indicators identified address multiple targets. For example, hydropower is both an ecosystem service and driver of other ecosystem service loss.

Three major ecosystem services, or groupings of services, stand out for consideration. The first is provisioning clean water (or regulating water quality). The second is water availability (water quantity) in all its dimensions including both mean availability and extremes in availability (floods and drought, both of which relate directly to disaster risk reduction). These are central to the concept of water security for both ecosystems and people. Water quality has received some attention in previous indicator assessments

[2] As of May 2011, that is predating the outcomes of the AHTEG on indicators in June 2011.

under the Convention on Biological Diversity, but water quantity less so. Each has very high socio-economic value and some of the most direct links to human well-being. The third is sediment transfer, a complex process involving terrestrial, freshwater and coastal systems and multiple ecosystem services, and is hydrologically driven. Disruptions in sediment transfer have extraordinarily high economic and ecological consequences and the topic is largely absent from previous Convention on Biological Diversity indicators work. Other indicator areas covered include: water and other provisioning services (food and hydropower), disease regulation and indicators of relevant enabling conditions.

Based on criteria, including indicator availability and/or ease of development, the following preliminary short-list of key indicators is identified. For each, the justification, relevant biodiversity storylines and a description of metrics and data availability is provided, together with the targets they chiefly address (in most cases these are multiple). Most are already in use by other processes in particular the Millennium Development Goal (MDG) indicators and by the Commission on Sustainable Development and most are in use at national level.

1. Primary indicator area: clean water

Secondary indicator 1.1: *MDG 7 c Indicator 7.8 Proportion of population using an improved drinking water source* (in use)

- the source of practically all drinking water is wetlands

Secondary indicator 1.2: *MDG Target 7c Indicator 7.9: Proportion of population using an improved sanitation facility* (in use)

- a high profile MDG target and major driver of water quality degradation

Secondary indicator 1.3: *Water quality* (in use)

Secondary indicator 1.4: *Wastewater treatment* (in use)

Secondary indicator 1.5: *(a) Proportion of cities obtaining water supplies from protected areas; and/or (b) Proportion of protected areas established and managed primarily to protect water supplies* (to be derived)

Secondary indicator 1.6: *Area of wetland used in water treatment (including both natural and constructed wetlands)* (needing development)

Secondary indicator 1.7: *Access to improved drinking water based on change in water quality* (under development through FAO LADA/UNCCD)

2. Primary indicator area: water availability/water security

Secondary indicator 2.1: *Water scarcity* (or presented as *"Proportion of total water resources used"*) (in use)

Secondary indicator 2.2: *Water use intensity by economic activity* (in use)

Secondary indicator 2.3: *Human and economic losses due to water-related natural disasters* (in use)

Secondary indicator 2.4: *Percentage of population living in water hazard prone areas* (needs development)

Secondary indicator 2.5: *Land affected by desertification* (in use)

- desertification is defined by the loss of water from land

Secondary indicator 2.6: *Water footprint* (needs some development)

Secondary indicator 2.7: *Soil moisture* (likely available soon from new remote sensing data)

- a key indicator for land productivity and regarding water regulation

Secondary indicator 2.8: *Climate moisture index (CMI) (Aridity index)* (in use)

Secondary indicator 2.9: *Extent of terrestrial carbon storage vulnerable to water insecurity* (can be derived from water scarcity and carbon storage metrics)

Secondary indicator 2.10: *Trends in number of water-related conflicts and number/magnitude of inter-state conflicts* (needs some development)

3. Primary indicator area: sediment transfer

3. Indicator: *Sediment transfer* (partly available, needs to be further derived)

- a critical subject to capture

4. Provisioning services related:

Secondary indicator 4.1: *Actual hydropower installed capacity/potential capacity* (in use)

Secondary indicator 4.2: *Area water-logged by irrigation* (in use)

Secondary indicator 4.3: *Area salinized by irrigation* (in use)

Secondary indicator 4.4: *Crop water productivity* (in use)

- a very important indicator of trends in agricultural efficiency (and preferable to agricultural water use - which is a subset of water use by economic activity)

5. Disease regulation:

Secondary indicator 5.1: *Population affected by water-related diseases* (in use)

Secondary indicator 5.2: *Parasite loadings* (needs further work)

6. Indicators of enabling conditions (water-related):

Secondary indicator 6.1: *Incorporation of water-related ecosystem services into national planning processes* (can be derived from existing sources)

Secondary indicator 6.2: *Progress in implementation of Integrated Water Resources Management (IWRM)* (in use)

Secondary indicator 6.3: *Women represented in water management* (under development, included in response to the tenth meeting of the Conference of the Parites request to capture gender)

Some of the above are direct measures of ecosystem services (benefits), some are drivers of service degradation, whilst some are both.

This note has not yet fully explored the opportunities for using existing direct measures of biodiversity (such as species and biome-based indicators) to further underpin the storylines that these indicators open up.

Most of the main impacts of climate change are delivered through changes to the hydrological cycle. But most reviews regard climate change as a major but additional driver of shifts in hydrology to direct anthropogenic water and land use change. Climate change storylines are probably best derived as sub-storylines using other ongoing assessments of this subject and their indicators.

One clear opportunity is to move beyond using individual indicator metrics to using integrated indicators and in particular approaches which combine biodiversity, ecosystem, ecosystem services and human welfare metrics. Some promising published approaches in this regard are noted but this topic is not developed further here.

Some of the indicators identified here, and how they capture various ecosystem and socio-economic dimensions, are shown in figure 1.

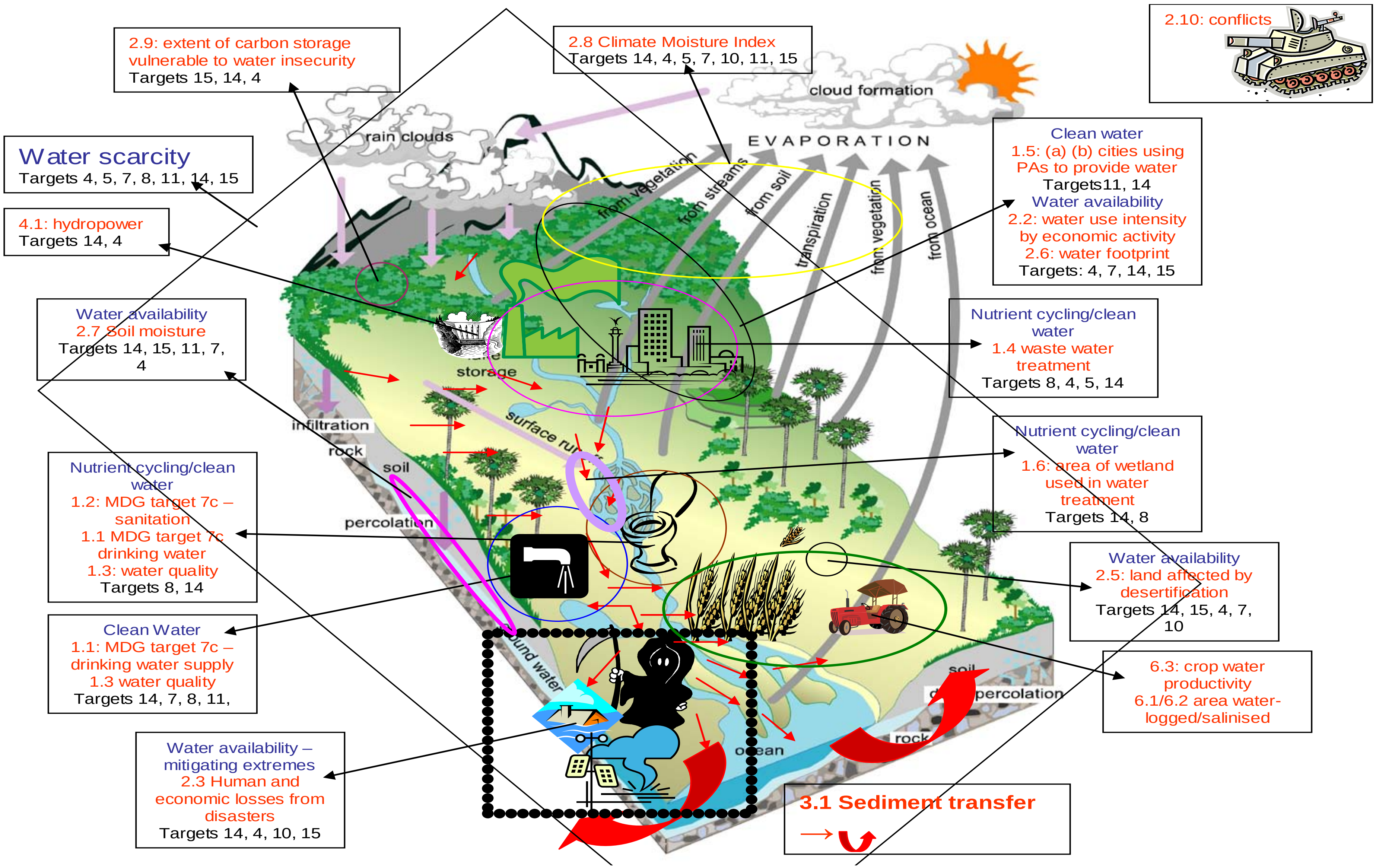

Figure 1: A simplified diagram of how the various indicators capture water dimensions of ecosystems, economies, human well-being and CBD targets.

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I. INTRODUCTION

1.1. Background

1. This note was prepared by the Executive Secretary in collaboration with the Secretariat of the Ramsar Convention to support the considerations of the Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020, held in High Wycombe, United Kingdom, from 20 to 24 June 2011.

2. There are multiple and important reasons why indicators for water and water-related ecosystem services need to be well captured for the Strategic Plan. These extend beyond the needs for monitoring alone and include, for example, the opportunities for strengthening engagement by a broader range of stakeholders in implementation. In addition, several sections of the Strategic Plan (and some of the Aichi Biodiversity Targets themselves) explicitly call for attention to water and water-related ecosystems services: notably, for example, in paragraph 17 (g) of decision X/2 (the Strategic Plan) footnote 7: "the paramount importance of water should be highlighted in the technical rationale of target 14".

3. This note builds on previous work, including in particular the report on suggested targets and indicators for the Strategic Plan post 2010 prepared by the Ramsar Secretariat and Scientific and Technical Review Panel in collaboration with the Secretariat of the Convention on Biological Diversity as an information note for SBSTTA 14 (UNEP/CBD/SBSTTA/14/INF/3), CBD (2011), and a Biodiversity Indicators Partnership Integrated Water Storyline Workshop, Gland, Switzerland, 29 November to 1 December 2010. It also benefits from the involvement of both the Convention on Biological Diversity and Ramsar Secretariats in UN-Water,[3] including the development of a monitoring and indicator process under the World Water Assessment Programme. The latter institutional environment has been particularly beneficial regarding relevant indicators in use by other (non-biodiversity) interest groups and as a means for identifying where major opportunities might lie with regards to forging better links between biodiversity and the many and divergent interests in water.

1.2. Setting the context for indicators: some relevant points from Convention on Biological Diversity Conference of the Parties decisions

1.2.1. The Strategic Plan for Biodiversity and the Aichi Biodiversity Targets (decision X/2)

4. The Strategic Plan for Biodiversity 2011-2020 is much more than its targets. In decision X/2, the Conference of the Parties laid down the context, objectives and key needs for the Strategic Plan which have bearing upon the selection and use of indicators, including , *inter alia*, to:

(a) "Enable *participation* at all levels to foster the full and effective contributions of women, indigenous and local communities, civil-society organizations, the private sector and stakeholders from all other sectors in the full implementation of the objectives of the Convention and the Strategic Plan" (para. 3 (a));

(b) *Integrate* "biodiversity targets into national development and poverty reduction policies and strategies, national accounting, as appropriate, economic sectors and spatial planning processes, by Government and the private sector at all levels" (para. 3 (d));

[3] UN-Water is an inter-agency coordination mechanism currently comprising 29 United Nations agencies, plus 4 United Nations initiatives with special partner status, and 20 non-United Nations partner organizations. All these are working globally and have an interest in one or more aspects of water.

(c) *Emphasize* "that increased knowledge on biodiversity and ecosystem services and its application is an important tool for communicating and mainstreaming biodiversity", and to "make use of the findings of the study on The Economics of Ecosystems and Biodiversity and other relevant studies, to make the case for investment for biodiversity and ecosystem services and to strengthen policy commitment to biodiversity at the highest level" (para. 7);

(d) *Mainstream gender considerations*, "where appropriate, in the implementation of the Strategic Plan for Biodiversity 2011-2020 and its associated goals, the Aichi Targets, and indicators" (para. 8);

(e) "Further develop, in preparation for the consideration of this issue by the Subsidiary Body on Scientific, Technical and Technological Advice at its fifteenth meeting, and the Working Group on Review of Implementation at its fourth meeting, the technical rationales and suggested milestones for the Aichi Biodiversity Targets contained in the note by the Executive Secretary (UNEP/CBD/COP/10/9) taking into account comments made at the tenth meeting of the Conference of the Parties" (para 17 (g)), including that "the paramount importance of water should be highlighted in the technical rationale of target 14" (footnote 7);

(f) That "the purpose of the Strategic Plan for Biodiversity 2011-2020 is to promote effective implementation of the Convention through a strategic approach, comprising a shared vision, a mission, and strategic goals and targets (the Aichi Biodiversity Targets), that will inspire broad-based action by all Parties and stakeholders" (annex, para. 1);

(g) Address "insufficient *integration of biodiversity issues into broader policies, strategies, programmes and actions*, and therefore that the underlying drivers of biodiversity loss have not been significantly reduced" and that "while there is now some understanding of the linkages between biodiversity, ecosystem services and human well-being, the value of biodiversity is still not reflected in broader policies and incentive structures" (annex, section I, para. 5);

(h) "The vision of the Strategic Plan is a world of 'Living in harmony with nature' where 'By 2050, biodiversity is valued, conserved, restored and wisely used, *maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people'* " (annex, section II, para. 11);

(i) "The mission of the Strategic Plan is to 'take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to *provide essential services*, thereby securing the planet's variety of life, and *contributing to human well-being, and poverty eradication*" (annex, section II, para. 12); and

(j) "The *participation of all relevant stakeholders* should be promoted and facilitated at all levels of implementation" (annex, section V, para. 14).

5. Section V of decision X/2, on implementation, monitoring, review and evaluation, also notes the requirements for, *inter alia*:

(a) *broadening political support* for the Strategic Plan and the objectives of the Convention is necessary, for example, by working to ensure that Heads of State and Government and the parliamentarians of all Parties understand the value of biodiversity and ecosystem services (para. 16); and

(b) partnerships at all levels are required for effective implementation of the Strategic Plan to (i) ensure that the Convention, through its new Strategic Plan, *contributes to sustainable development and the elimination of poverty, and the other Millennium Development Goals*; (ii) ensure cooperation to achieve implementation of the Plan *in different sectors*; (iii) promote biodiversity-friendly practice by *business*; and (iv) *promote synergy and coherence* in the implementation of the multilateral environmental agreements (para. 17).

1.2.2. Outcome-oriented goals and targets and associated indicators and consideration of their possible adjustment for the period beyond 2010 (decision X/7)

6. In paragraph 3 of decision X/7, the Conference of the Parties agreed to use the global primary indicators in decision VIII/15 and in annex III of document UNEP/CBD/SBSTTA/14/10 and to complement these with additional indicators which are suitable for monitoring progress towards those targets for which suitable indicators have not yet been identified, in particular in relation to the economics of biodiversity and ecosystem services and the benefits to people derived from these services and, *inter alia*, taking into account indicators developed under other multilateral environmental agreements and international organizations and sector-based processes. In particular, in paragraph 5 of this decision, the terms of reference for the Ad Hoc Technical Expert Group, *inter alia*, include to suggest additional indicators noting the lack of agreed indicators for ecosystem services, and making use, where appropriate, of the indicators developed by other multilateral environmental agreements, organizations, or processes.

1.2.3. Inland waters biodiversity (decision X/28)

7. This decision is relevant to the subject of water, the rationale and indicators for it and the Strategic Plan. Some key points the decision emphasizes include, *inter alia*, that:

(a) “Water provisioning, regulation and purification: (a) are *critically important services* provided by ecosystems, underpinned by biodiversity, and essential to sustainable development; (b) are essential for the continued functioning of terrestrial, inland and coastal ecosystems and the existence of biodiversity within these”; and (c) “*there is a clear scientific and technical basis to strengthen attention to water across all relevant interests and programmes of work of the Convention”* (para. 46);

(b) “Water is widely regarded to be *the primary global natural resource challenge* and a *key natural resource link between the various Millennium Development Goals* (MDGs) and biodiversity” (para. 4);

(c) “The findings of the Intergovernmental Panel on Climate Change technical report *Climate Change and Water*, which concludes, *inter alia*, that the relationship between climate change and freshwater resources is a matter of primary concern as water quality and availability will be severely affected by climate change” (para. 22);

(d) “The carbon cycle and the water cycle are perhaps the two most important large-scale biogeological processes for life on Earth and that these two cycles are broadly linked” (para. 23);

(e) Water provides strong linkages between biodiversity, climate change and desertification, and hence attention to it a means to strengthen coordination and synergies between the Convention on Biological Diversity and other multilateral environmental agreements, such as the United Nations Convention to Combat Desertification, the United Nations Framework Convention on Climate Change and the Ramsar Convention on Wetlands (para. 27); and

(f) “There are opportunities presented by the recognition of the role of biodiversity in water provisioning, regulation and purification, and hence sustaining water resources, […] to mainstream biodiversity into all sectors and levels of government and society as a contribution to the achievement of the objectives of the Convention” (para. 47).

8. Paragraph 42 also "notes the role of biodiversity and ecosystems in providing services that reduce vulnerability to *the impact of some natural disasters*, in particular water-related impacts such as flooding and drought, and that current global changes are anticipated to increase disaster vulnerability and risk."

1.3. Criteria for indicator selection and development

9. From the above, a set of general principles is derived that help guide the search for indicators as follows:

(a) The main focus of the Strategic Plan is on ecosystem services and benefits to people, as reflected in both its vision and mission;

(b) The primary need is to promote engagement (implementation) by the broadest range of stakeholders, especially political, economic, development, public interests etc.;

(i) indicators, therefore, preferably need to have resonance with those interests;

(ii) indicators are both a means to monitor progress and a means to communicate with these wider interests; indicators, *inter alia*, should, where possible, indicate (communicate) what the Strategic Plan is about; ideally they should indicate as clearly and directly as possible "your business depends on our business";

(iii) indicators which overemphasize direct measures of biodiversity can deliver incomplete, if not skewed, messaging to stakeholders, unless properly articulated as surrogates for trends in ecosystem services or supported by direct measures of those trends;

- and in many cases the same metrics (for example for trends in species) can be tailored to better reflect trends in services or at least trends in ecosystems delivering the services;

- the lack of balance between biodiversity (e.g., species, habitats) and ecosystem services metrics in the 2010 biodiversity target indicator cluster is a well-known weakness in that process (as recognized by the tenth meeting of the Conference of the Parties drawing attention to the need for improved ecosystem services indicators);

(c) An ideal indicator would therefore be one already in use by other processes, particularly those with a high profile, such as the Millennium Development Goals. At first sight, the options for this might seem limited (although, unsurprisingly with water, some key opportunities are identified in this note), but very often targets/indicators are in use by other processes that can be interpreted in biodiversity terms; one task of the biodiversity indicators process, therefore, should be to redirect effort towards interpreting being used by other stakeholders in biodiversity-relevant terms.

10. The selection, use and development of ecosystem service related indicators also require that the constituency of practitioners for monitoring and indicators be considerably broadened. For example, this note benefits considerably from the experiences of UN-Water, whose collective interests are very diverse and include human health, economic and social, business, gender, tourism and culture, science, investment and financing, and labour interests, in addition to environment and conservation, as well as a broad-based development agenda.

11. The key messages arising from the Convention on Biological Diversity (2011) for developing ecosystem service indicators follow most of the above logic and are to:

(a) Ensure objectives are clear;

(b) Adopt a small set of specific, policy-relevant indicators;

(c) Go beyond provisioning services;

(d) Start with the basics – use existing data and proxies first (but recognize limits);

(e) Engage stakeholders (and cross-sectoral collaboration) from the outset;

(f) Think about sustainability – include indicators for both ecosystems and benefits;

(g) Don't sideline biodiversity;

(h) Be sensitive to scale;

(i) Assess trends and consider trade-offs; and

(j) Communicating has got to be right:

(i) Be clear about what indicators are telling you;

(ii) Be transparent about uncertainty;

(iii) Use maps (spatially explicit data) where possible;

(iv) Avoid over-simplification, and;

(v) Economic metrics are useful but do not ignore non-monetary values.

12. The criteria used by UNCCD (2011) to evaluate indicators were:

(a) Does the indicator provide information about changes *in important processes*?

(b) Is the indicator *sensitive enough to detect important changes* but not so sensitive that signals are masked by natural variability?

(c) Can the indicator *detect changes at the appropriate temporal and spatial scale* without being overwhelmed by variability?

(d) Is the indicator based on *well-understood and generally accepted* conceptual models of the system to which it is applied?

(e) Are *reliable data available* to assess trends and is data collection a relatively straightforward process?

(f) Are *monitoring systems in place* for the underlying data needed to calculate the indicator?

(g) Can policymakers easily *understand* the indicator?

13. It is noted that scientific criteria, whilst obviously important, dominate the criteria used by CBD (2011) and UNCCD (2011). A weakness of both is attention to the importance of communication with broader interests (mainstreaming) etc., and other objectives of the Strategic Plan, as outlined above. This note presents an argument that this is as, if not more, important than science. For this reason, *additional*, or related, criteria for indicator selection used to guide consideration of indicators in this note were as follows (with an indication of relative weighting in brackets):

Messaging power:

Resonance with stakeholders/interest groups beyond environment/biodiversity (very high)

Storyline:

Ability to open the relevant storylines – onto which additional monitoring/indicator work can build (very high)

Economic importance

The economic importance of the storyline (impact of the trend in the ecosystem service), including degree of direct relevance to human populations, poverty reduction and human well-being; that is "value" of the ecosystem service (very high)

Indicator availability

Extent to which an indicator already exists, is in use by other agencies/processes and can be accessed "off the shelf" (very high)

Or:

Potential for development

The ease by which an indicator can be developed (should it not be readily available) or is being developed by other interest groups. Higher priority is assigned to those indicators where development is ongoing, by others, and there is capacity and interest in the indicator for other purposes (medium).

1.4. Storylines

14. It is important to consider indicators in terms of their ability to support the priority storylines and to note that these relate to human well-being. Many of these storylines already exist and are derived independent of biodiversity data.

15. Primary indicators should function to open up headline stories that need to be told. Secondary storylines and indicators shed light on subsets of these headlines. Storylines would often, if not mainly, be based on information coming from multiple sources, including other quantitative and qualitative indicators (whether formally recognized or not) and trends in other storylines (and their indicators).

16. The ability to tell the stories will change because data, indicators, monitoring and the science behind them change, and often very quickly. Water quality, as a primary indicator (in the 2010 target monitoring framework), for example, is based on a suite of metrics which have changed over time, as old pollutants come under control, new ones emerge. Indicators open up a story but may not necessarily tell the whole story, nor eventually most or even any of it. As an example, although a key set of biodiversity

indicators laid a foundation, the largest proportion of analysis to support storylines developed for the Global Biodiversity Outlook 3 was based on information not directly adopted in the 2010 indicators framework.

17. With regards to the indicators process for the Aichi Biodiversity Targets, an important strategic question relates to whether the indicators set that is developed either (a) considerably expands and proliferates, or (b) attempts to simplify and engage. The proliferation of indicators is motivated partly by practitioners promoting formal recognition of their metrics as well as attempts to actually develop a comprehensive set of formally adopted indicators. Simplification would be an agreement on the overall headline stories and primary indicators that are relevant but leaving the details out (specific indicators or particular metrics). Indicator practitioners, of which there are many and extending well beyond the biodiversity indicators community, could then undertake the necessary science, using the most appropriate indicators and metrics of their choice, as available, and contribute in their own way to support the necessary headline stories.

18. In view of the very broad nature of the Aichi Biodiversity Targets and the fluid nature of indicators there is a strong argument for flexibility in monitoring and reporting. A key question is whether the Convention on Biological Diversity process, the Ad Hoc Technical Expert Groups (AHTEGs), The Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) and the Conference of the Parties (COP) indeed needs to adopt specific metrics at all. For each target, it is useful to know that at least key primary/secondary indicators exist. For each, the current availability of metrics, and the need to fill gaps, needs to be known. But these do not necessarily need to be adopted. An adaptive indicator framework makes sense, whereby there is understanding of what we need to be reporting about but the ways and means to do it are determined by relevant specialist stakeholders.

19. To conclude, notwithstanding the need to be confident that at least some credible indicators are available or can be developed, the storyline is more important than the indicator adopted for it.

1.5. Integrated indicators

20. Perhaps one of the most important needs is to move effort on from identifying individual indicators and metrics to addressing the opportunities to develop clusters of metrics (integrated indicators) which capture broader storylines. One problem with developing a comprehensive set of individual indicators, even if such were feasible, would inevitably be that each would likely provide a different, and often conflicting, storyline. At present, reporting on the biodiversity indicators set collectively is addressed largely through report production which, although usually genuinely attempting to maintain impartiality and objectivity, can sometimes be forced to drift from a solid science base.

21. An example of one such integrated approach is that of Vörösmarty et al. (2010) who analysed water security and river biodiversity using 23 stressors (drivers), grouped into four major themes representing environmental impact (catchment disturbance, pollution, water resource development and biotic factors) to develop a common assessment framework for regional and planetary threats. The authors acknowledge that the scientific methods can be improved. But the principles of the approach are highly relevant. Biodiversity indicators are more meaningful when they contribute to a storyline which addresses human welfare. In this example there was high merit in linking the fate of humans with that of biodiversity in the same integrated approach. As witness to the advantages of this approach, apart from commanding the front cover of an issue of *Nature*, the said results were instantly taken up by the work for the next World Water Development Report. This is because it addressed what we need to know - the status of human security. There are considerable opportunities to improve this kind of approach towards 2020.

22. UNCCD (2011) illustrates another attempt at generating integrated indicators. For example, the proposed Ecosystem Services Status Index (ESSI) considers the biophysical status of biomes, soil health, water quantity, biodiversity and socio-economics. The ESSI describes the actual state of the ecosystem to provide goods and services. The index is calculated by combining the 4 biophysical status axes and the 2 socio-economic ones in a single rating. This approach shows particular promise for further development for the Convention on Biological Diversity by combining relevant metrics from the relevant Aichi Biodiversity Target indicators (noting though that socio-economic indicators is a gap in the current set). Yet another example is the "Level of Land Degradation" in use by the UNCCD which is a proxy measure of ecosystem service delivery obtained by combining primary soil, vegetation and water degradation assessments.

23. The FAO-led Land Degradation Assessment in Drylands (LADA) and its Global Assessment of Land Degradation and Improvement (GLADA) through its Global Land Degradation Information System (GLADIS) (FAO-LADA 2010) inventories *changes in ecosystem goods and services by land use system* in each country. GLADIS outputs are a series of global maps on the status and trends of the main ecosystem services that can be queried and downloaded. These are supplemented by a larger range of maps and databases that document the input data used to determine individual axis parameters. Ancillary maps such as a global land use systems map with attributes are also included. GLADIS provides information at subnational level both on degradation processes and on degraded status of the land. Most general types of land degradation are covered (soil erosion by water, salinization, compaction, nutrient decline, pollution, water, biomass and biodiversity decline). GLADIS therefore integrates water-related metrics with other land use and biodiversity aspects etc. (using similar data/metrics for direct water measures as captured below in this document). This approach has high relevance for integrated approaches to ecosystem services indicators, and has particular relevance to target 7, and deserves much more detailed attention in general for the indicators for the Aichi Biodiversity Targets.

II. A CONCEPTUAL FRAMEWORK FOR THE AICHI BIODIVERSITY TARGETS – THE CENTRALITY OF TARGET 14

24. Based on decision X/2 and the Strategic Plan for Biodiversity 2011-2020 (decision X/2, annex) and its rationale, vision and mission, a conceptual framework emerges (Figure 2) which is useful to illustrate how the various goals and targets relate to each other and to the vision and mission. It is also useful to identify that the goals (and their targets) can be grouped (loosely) into those creating an enabling environment, those involving direct actions and those reflecting the desired state (figure 2).

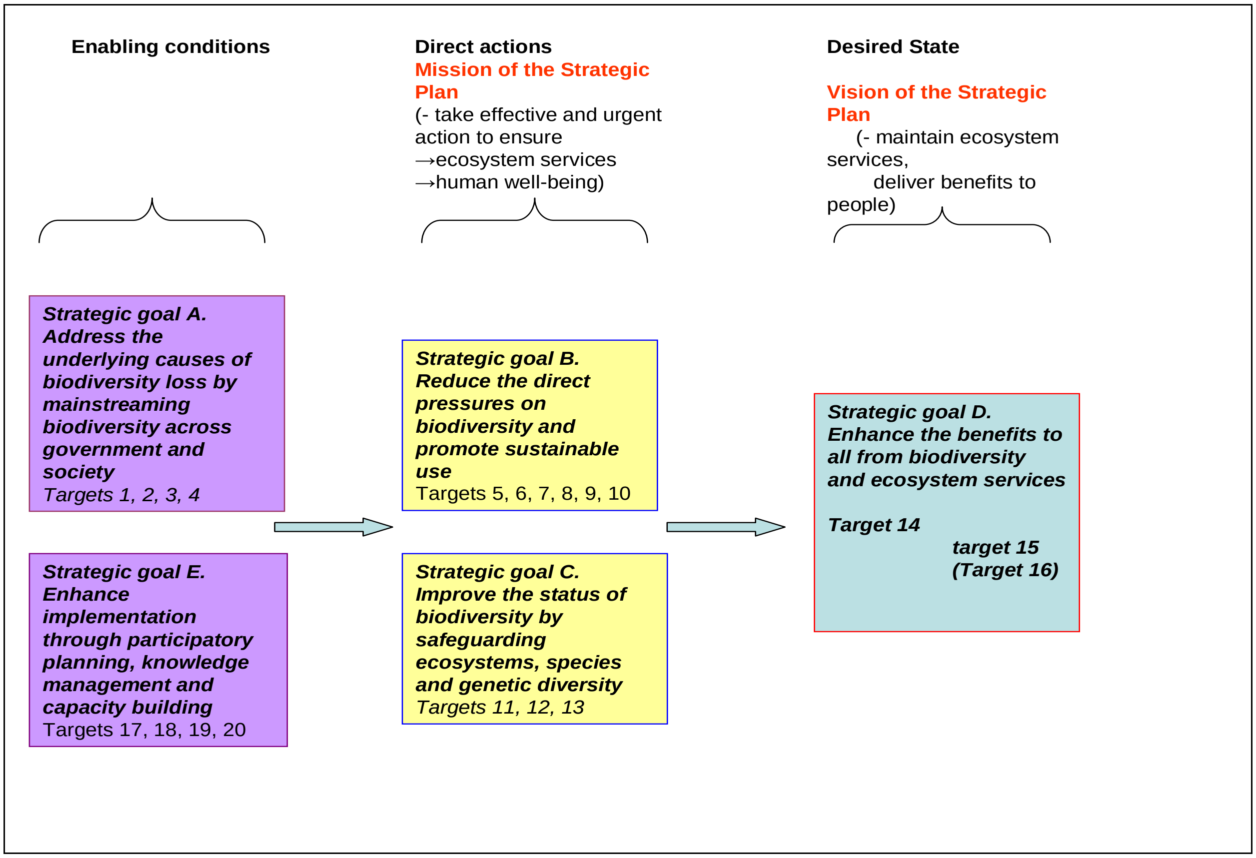

Figure 2: a conceptual framework for the Strategic Goals and Aichi Biodiversity Targets of the Strategic Plan based on decision X/2. This is simplified, noting in particular that there are both positive and negative feedbacks between the desired state (target 14) and the enabling conditions (e.g., demonstrating the value of the desired state should promote improved enabling conditions, *vice versa* if goals A and E do not result in tangible progress on target 14).

25. The key target that addresses ecosystem services specifically and directly is target 14. Target 15 is technically a subset of target 14: carbon stocks, climate change mitigation and adaptation, in the biodiversity context, are all ecosystem services, and "resilience" presumably refers to the ability to sustain the delivery of these ecosystem services. Target 15 is therefore, technically, already captured under the umbrella of target 14. Targets 6 (fisheries) and 7 (areas under agriculture, aquaculture and forestry) are also arguably subsets of target 14 since the products of fisheries, agriculture, aquaculture and forestry are also ecosystem services. Regarding target 16 it is noted that the benefits in question (arising from genetic resources) are also an ecosystem service and in that sense are also a subset of target 14 – although noting that the specific wording of target 16 refers to an enabling process not an outcome. Target 11 specifically mentions "ecosystem services" but protected areas, to which the target refers, are a means to sustain them and hence target 11 is either (technically) a subset of 14 or a contribution (action) towards it.

26. The case is therefore made that target 14 is the umbrella target regarding ecosystem service <u>outcomes</u> and that these other targets are either subsets of target 14 or ways and means to achieve the desired ecosystem service outcomes reflected in target 14.[4] This does not mean that the other targets are less important. But it is useful to consider target 14 as the desired "product" of the Strategic Plan. The key point is that target 14 is in effect the measure of the Vision of the Strategic Plan. Not only is this derived

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[4] This is a theoretical and conceptual analysis. It is noted that there are reasons why the Aichi Biodiversity Targets are constructed in the way presented in decision X/2 and as determined solely by the Conference of the Parties.

from the above logic (and as illustrated in Figure 2) but also by the close similarity in the wording of the target and the Vision.[5]

27. Strategic Goals C and D (and their targets) are generally an expression of the Mission of the Strategic Plan.[6] Strategic Goals A and E and their targets, generally, refer to creating an enabling environment for the Mission (actions) to contribute to the Vision (desired state).

28. The above has important practical implications. It points to the fact that target 14 (including subsets as described above) is not just one amongst 20 targets but *achieving target 14 is the indicator for effectiveness of the whole Strategic Plan*. For this reason, addressing monitoring and indicator requirements for target 14 (and its logical subsets as noted above) is essential. Yet these indicators remain the weakest link. Progress towards most of the other targets gives us information about our efforts but not whether they have been successful.

29. It is obvious that the monitoring and indicator process needs to adequately address the current gaps regarding target 14. But Figure 2 also points to the need to look at needs and opportunities for ecosystem service related indicators in terms of the required direct actions and enabling conditions (goals C and D, and A and E, respectively, and their respective targets). It is an unsound assumption that all activities or enabling conditions will necessarily lead equally to a positive impact on target 14. In effect, these other targets need to be assessed specifically with regards to their impact on target 14.

30. Since the Vision of the Strategic Plan is largely about ecosystem services it makes sense to favour direct ecosystem service indicators (and not "biodiversity" metrics) to monitor progress towards targets where feasible and appropriate. Biodiversity-based metrics would, generally, have two key roles: (i) as surrogates for ecosystem services where direct measures are not available; and (ii) to illuminate the linkages between biodiversity and ecosystem services indicators where these are available.

III. THE STRATEGIC PLAN, AICHI BIODIVERSITY TARGETS AND HUMAN DEVELOPMENT INDICATORS

31. The vision of the Convention on Biological Diversity Strategic Plan includes "delivering benefits essential for all people", and in particular its Mission is to, *inter alia*, "...contribute to human well-being and poverty eradication". However, only Strategic Goal D (“*enhance the benefits to all from biodiversity and ecosystem services”*) and target 14 ("*...essential services...health...livelihoods and well-being...the poor and vulnerable*") make <u>explicit</u> references to human well-being.[7]

32. More notably, amongst the full suite of indicators used for the 2010 target, and so far considered for the Strategic Plan 2011-2020,[8] only one (*health and well-being of communities directly dependant on*

[5] Target 14 is: "By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable". The Vision of the Strategic Plan is a world of “Living in harmony with nature” where “By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.” (Note in this wording that the stated reason to value, conserve and restore biodiversity is to maintain ecosystem services and benefits for people, that is, ecosystem services).

[6] The Mission is to “<u>take effective and urgent action</u> to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet’s variety of life, and contributing to human well-being, and poverty eradication".

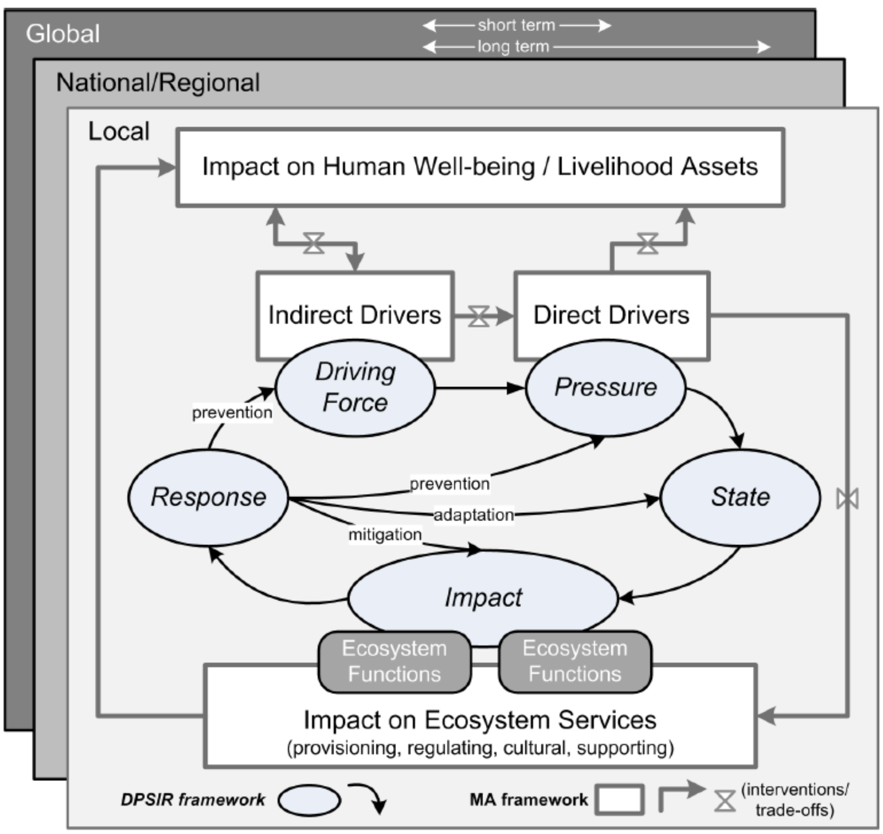
[7] The argument that in effect the other goals and targets contribute to human development, via target 14, is noted in Figure 2.

[8] As of May 2011, that is pre-dating the outcomes of the AHTEG in June 2011

ecosystem goods and services) refers directly to human well-being, and even for that, data/metrics are considered not available at the global level (BIP 2010, annex I).

33. By contrast, the set of impact indicators being developed for the UNCCD includes very prominent attention to human development related indicators[9] (UNCCD 2011). These are largely in relation to UNCCD objective 1 (to improve the living conditions of affected populations) and 3 (to generate global benefits through effective implementation). This enables the UNCCD indicator framework to speak much more directly to development interests.

34. The UNCCD process also involved development of a conceptual framework (Figure 3), largely based on a combination of a modified DPSIR framework and the Millennium Ecosystem Assessment conceptual framework, and its consideration in an evaluation matrix together with guidance on rating indicators. The 2010 Biodiversity Indicators Partnership also presented a simpler but related conceptual framework (BIP 2010, e.g., figure 5) but the UNCCD version is more explicit regarding ecosystem services and human development.



* (Source: Adapted from GEF KM:Land 2010 & FAO LADA 2009)

Figure 3: The draft UNCCD conceptual framework for evaluating indicators (UNCCD 2011).

35. A weakness with the Aichi Biodiversity Targets (and the current indicators list) is the decoupling from development interests created by the absence of direct measures of human development impacts. Necessary links between biodiversity and development (and between the targets and the mission of the Strategic Plan) can still be generated through the right storylines, but it requires reconstruction, much along the lines of Figure 2. The best way now to strengthen the messaging power of the Strategic Plan is

[9] For example, maternal mortality ratio, proportion of chronically undernourished children under age of 5 in rural areas, rural poverty rate, access to safe drinking water and at least initially The Human Development Index (UNDP), etc.

to reconnect it explicitly to human well-being through indicators. That means using indicators which mention people, or their well-being. For this reason, the current note places the utmost importance on identifying these indicators.

36. Another approach that would achieve the same purpose, perhaps even better, would be to explore indicators directly for the Vision and Mission of the Strategic Plan. Unfortunately the AHTEG was not requested to look at this. But given the centrality of human development to the Vision and Mission of the Strategic Plan it is clear that attention is needed to having indicators for these.

IV. WATER AND WATER-RELATED AND DEPENDENT ECOSYSTEM SERVICES

37. Capturing the water dimension of ecosystem services involves two main considerations. The first is that water (meaning freshwater) is required to support all terrestrial ecosystem functioning, and obviously wetlands, and indeed is highly influential on a large part of coastal ecosystem functioning. Therefore, water (as a resource) underpins all ecosystem services. Changes in its availability (and quality) affect all ecosystem service delivery (with the exception of some delivered by oceans). For example, the entire world's food production (excepting marine production) depends on water and is highly vulnerable to changes in it. Likewise for all forest services. This is the first reason why water has paramount importance for target 14.

38. The second point is that the availability of water in appropriate quantities and quality are also services provided by ecosystems (water provisioning and regulation). This water not only underpins everything else (as above) but is also probably the most important natural resource required directly by people: the second reason for "paramount importance".

39. Considering water and ecosystem services and functioning can be complicated. For example, the ability of ecosystems to supply water, of adequate quality, is also underpinned by water availability (water loss from forests, for example, reduces the ability of forests to support water availability and quality).

40. Water is essentially a cross-cutting subject. These feedbacks make the subject of water in the Strategic Plan, and the Aichi Biodiversity Targets, potentially complex but of central importance. If there is a simpler approach it is that water is crucially important, connects everything and needs to be managed without boundaries.

41. A list of some of the services provided by ecosystems, with notes on the role of water, is provided in Table 1.

Table 1. Some linkages between ecosystem services (as per the Millennium Ecosystem Assessment) and water.

Ecosystem Service provided by inland waters (with some examples)	Some examples of the services provided	Examples of linkages
Provisioning services		
Food	Production of fish, wild game, fruits, grains, etc.	Required for ecosystems to function to produce food. Key considerations are (i) irrigation water availability; (ii) soil moisture availability; (iii) groundwater recharge; (iv) sustaining rainfall
*Freshwater**	Storage and retention of water for domestic, industrial and agricultural use	Direct
Fibre & Fuel	Production of logs, fuel wood, peat, fodder, biofuels	Underpinned by water availability and quality
Energy	Hydropower	Direct
Biochemical	Extraction of medicines and other materials from biota	Underpinned by water availability and quality
Genetic materials	Genes for resistance to plant pathogens, ornamental species, etc.	Underpinned by water availability and quality
Regulating services		
Climate regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes	Ecosystems (biodiversity) supports local and regional water cycles (e.g., evapotranspiration and precipitation) Carbon storage by ecosystems underpinned by water availability (carbon and water cycles intimately related)
Water regulation (hydrological flows)	Groundwater recharge/discharge	Direct
	Wetland hydrological functioning	Direct
	Soil moisture	Underpinned by (i) precipitation, (ii) land cover and (iii) soil biodiversity (functions)
Water purification and waste treatment	Retention, recovery and removal of excess nutrients and	Direct. Relates to (i) nutrient cycling, and (ii) sustaining water quality

Ecosystem Service provided by inland waters (with some examples)	**Some examples of the services provided**	**Examples of linkages**
	other pollutants	
Erosion regulation	Retention of soils and sediments	Erosion is driven by (i) loss of soil functions (e.g. soil moisture retention), and (ii) water is the key physical means by which erosion occurs Desertification, by definition, is a process driven by the loss of water
Cultural services		
Spiritual & Inspirational	Source of inspiration and cultural heritage/identity.	Underpinned by water availability and quality Water often has high spiritual and inspirational value
Recreational	Opportunities for recreational activities	Most such services are underpinned by water availability and quality Water based recreational activities have high economic and social values
Aesthetic	Many people find beauty or aesthetic value in aspects of, for example, wetland ecosystems	Most such services are underpinned by water availability and quality Water has high aesthetic value
Educational	Opportunities for formal and informal education and training	
Supporting services		
Soil formation	Sediment retention and accumulation of organic matter	Water central to supporting soil functions (soil biodiversity)
Nutrient cycling	Storage, recycling, processing and acquisition of nutrients	Underpins water quality

* While freshwater was treated as a provisioning service within the Millennium Ecosystem Assessment it is recognized that it is also regarded as a regulating service by some sectors.

V. RELEVANT INDICATORS IDENTIFIED

42. This note details the key relevant indicators so far identified. The search began by first identifying what the key headline water-related ecosystem services are and then looking at what relevant indicators are in use in other processes. The Ramsar Convention was a major source of information which has been integrated here where relevant. Other processes so far explored include the indicator frameworks of: the Millennium Development Goals, the Commission on Sustainable Development, the UNCCD, the FAO, the United Nations Statistic Division, the World Bank and the World Resources Institute. UN-Water represents these and other interests and is a particularly useful forum for determining what the key water issues are and what indicators exist to monitor them.

43. The first three indicator areas included below refer to the three key water-related ecosystem service areas – clean water, water availability (including variations in it, including natural disasters) and sediment transfer. These are the "big three" and biodiversity has very strong links with each. There are sub-areas under each that are prominent storyline areas in themselves. For example, reduction in water-related disaster risk (flooding and drought) is a crucial ecosystem service, at the core of adaptation to climate change, and worthy of its own category, but technically is just the extreme of water availability. These are followed by attention to some other potentially important water-related ecosystem services indicators and some available indicators for process and enabling conditions.

44. This work concluded very early that starting the search for indicators with the targets as the entry point was very problematic. It was much easier, and probably more relevant, to seek the headline stories, explore indicators, then fit them to targets. This is partly due to the cross-cutting nature of water and therefore many of the indicators identified address multiple targets. Relevant targets are listed below for each indicator.

45. All the indicators listed are important. Those considered to qualify on exceptional grounds, based on the aforementioned criteria, for the indicator/monitoring framework for the Aichi Biodiversity Targets are indicated by (☺).

(1) Key ecosystem service 1 – provisioning of clean water (regulation of water quality)

Primary indicator 1: provisioning of clean water☺

Justification

Clean water is one of the most important ecosystem services in terms of human welfare. It is directly relevant to poverty reduction/sustainable development. Very high economic value. Very high political interest. Very high public interest.[10]

Almost 80 per cent of diseases in developing countries are associated with water, causing about 1.7 million deaths every year (WHO and UNICEF 2008).

Ecosystems (biodiversity) underpin this key ecosystem service – including wetlands and terrestrial ecosystems/land cover and functioning (e.g., forests). Hence this is a key topic in relation to target 14.

[10] UNEP/CBD/SBSTTA/INF/3 notes, for example, a survey showing that drinking water quality is the number one environment concern in the United States of America.

Water quality can be a measure of progress towards clean water but is also is also a measure of drivers: for example, pollution (target 8) is in effect an indicator of stresses on water quality and a de-facto indicator of losses in water purifying services. The term "clean water" is used here to describe the service in question because it probably has better understanding with stakeholders. "Water quality" is an alternative but actually a proxy of the service required, noting that water quality can indeed be poor. If "water quality" terminology is used the service would be "Maintenance of water quality". In any event, the key point is that this is a service and hence belongs under target 14.

Clean water is also a key service provided by protected areas (target 11).

For this topic, therefore, targets 14, 11 and 8 are related. Target 7 would also be relevant since impact on water quality is a criterion for sustainability.

Storyline:

The role of, and trends in, the ability of biodiversity (ecosystems) to underpin sustainable supplies of clean water and trends in drivers (and sources of drivers) resulting in the loss of such services (e.g., water pollution).

Some relevant sub-indicators and metrics useful for expanding biodiversity storylines (in addition to key secondary indicators below) might include:

- Extent and condition of wetland (including river) riparian zones/areal extent of riparian vegetation –indicator needing to be developed, likely partially derivable from protected area datasets
- Nitrogen and phosphorous loading – using approaches for this indicator with regards to sustainable land management (this indicator is partly captured elsewhere in the Aichi Biodiversity Target framework)
- Trends in freshwater populations and species correlated to water quality indices
- Water quality for biodiversity index

<table>
<tr>
<td>Secondary indicator 1.1 ☺

Millennium Development Goal target 7c: Halve, by 2015, the proportion of people without sustainable access to safe drinking water

Indicator 7.8 Proportion of population using an improved drinking water source

(Also adopted by the Commission on Sustainable Development)</td>
<td>Relevant targets
Main target – 14
Additional targets – 11, 8, 7</td>
</tr>
<tr>
<td colspan="2">Justification
The source of all drinking water is wetlands (except an insignificant amount collected directly from rainfall).</td>
</tr>
</table>

Catchments are also important in clean water supply (e.g., forests – Blumenfeld et al. 2010).

Indicator already in use in the MDG process and therefore a priority for direct adoption under the Aichi Targets (despite constraints in interpretation – see below). The Strategic Plan indicator process therefore should adopt this indicator – and then concentrate on reporting on the ecosystem/biodiversity storylines associated with it.

Storyline
Strategic Plan contributes directly to the MDGs.

Metric/data availability
This is a metric.

Already monitored by the MDG process (http://www.un.org/millenniumgoals).

Key monitoring undertaken by WHO and UNESCO.

Constraints
The source as per the MDG process includes poor-quality water treated artificially (which is in effect a cost incurred due to the loss of this ecosystem service). Current datasets and monitoring processes for MDG indicator 7.8 need to be engaged to see if it is possible to disaggregate the data by extent to which the water is provided by artificial treatment. Secondary and relevant metrics therefore need to explain trends in the ability of ecosystems to underpin this MDG target. See also indicator 1.7 below under development, which potentially addresses some of these needs. Irrespective of this constraint, this secondary indicator should be maintained on the grounds of resonance with development interests.

The MDG indicator and its monitoring focus on supplying clean water to disadvantaged groups (the poor). It is noted however that clean water supply is also a primary need of rich nations too – and one of the most prominent public concerns as well as a key issue for cities. Storylines (and indicators) therefore need to also capture this aspect of clean water.

Secondary indicator 1.2 ☺

Millennium Development Goal 7. Target 7.C: Halve, by 2015, the proportion of people without sustainable access to basic sanitation

Indicator 7.9: Proportion of population using an improved sanitation facility

(Also adopted by the Commission on Sustainable Development)

Relevant targets
Main target – 8
Additional targets - 14

Justification
This is a high profile water-related target under the MDGs. Lack of adequate sanitation is a major source of water pollution globally especially for human health risks but also the high levels of nutrients involved (eutrophication). This is directly relevant to human well-being as well as biodiversity directly (as a driver of biodiversity loss).

Over 80 per cent of sewage in developing countries is discharged untreated, thereby polluting rivers, lakes and coastal areas. Sixty-seven per cent of the world population may still be without improved access to sanitation in 2030 (WHO/UNICEF 2008). This means that ecosystems will continue to be expected to deal with this waste (provide nutrient cycling services).

Although this is largely an indicator of a pressure (driver) on water quality – it is noted that where adequate sanitation does not exist, ecosystems deal with the waste directly which is in effect an ecosystem service (target 14) although in many cases unsustainably. To develop storylines it would be useful to know the extent to which ecosystems (mainly wetlands) are managed sustainably as a means to recycle this waste.

This indicator is already in use by these other processes. The Strategic Plan indicator process therefore just needs to adopt this indicator – and then concentrate on reporting on the ecosystem/biodiversity storylines associated with it (although the storyline as a pressure, in both biodiversity and human health terms, is already patently clear).

Storyline
Strategic Plan and MDGs share a direct and common interest.

Metrics/data availability
This is a metric already monitored by the MDG process (http://www.un.org/millenniumgoals)

Key monitoring undertaken by WHO and UNESCO.

Constraints

Secondary indicator 1.3 *Water quality*	***Relevant targets*** **Main target - 8** **Additional targets – 14, 11, 7**

Justification
This is a key direct indicator of water pollution (target 8 and indicator 1.2) and clean water (Secondary indicator 1.1).

Water quality was already included as a key indicator for the 2010 targets and is already proposed for the Aichi Biodiversity Targets (UNEP/CBD/COP/10/27/Add.1).

It is noted however that these approaches have tended to view water quality from the perspective of it being a driver of biodiversity loss. The same indicator can be used to illuminate a trend in an ecosystem service: poor water quality being an indicator of the loss of provisioning of clean water; the improvement in water quality is (partly) an improvement in this ecosystem service.

Metrics/data availability
Various water quality parameters (these can vary over time).

Extensive data availability. See UNEP/CBD/COP/10/27/Add.1 and ongoing work by the BIP. The World Water Assessment Programme regularly reports on water quality in detail, reporting primarily through the World Water Development Reports series currently on a three-year cycle (next report due 2012). These report mainly on human well-being aspects.

Initiatives are also ongoing regarding the water quality for biodiversity index through, for example, the UNEP GEMS/Water Programme for the Biodiversity Indicators Partnership. Further technical information is available in Carr and Rickwood (2008).

Constraints
Previous interest in water quality (e.g., 2010 targets) has over-focussed on water quality impacts on biodiversity – whereas it is the impacts of water quality on human welfare that is most closely associated with ecosystem services and economic and socio-political interests. The criteria for water quality are different

between the two (biodiversity versus human welfare) – those relating to human health being well-established by the WHO. Fortunately, there is extensive ongoing reporting on human health aspects by these other processes and the task for monitoring the Aichi Biodiversity Targets is largely to capture this information in reporting for the Strategic Plan.

A constraint has been attempts to define a final list of relevant parameters (although some key ones can be easily determined). These change over time (some pollutants come under control and monitoring can decline, new pollutants emerge and sometimes are not monitored) and the key metrics differ between regions and water sources. A better approach for the Aichi Biodiversity Targets is to have "water quality" as the Secondary indicator and to leave it to specialists in this area to report on relevant trends over time and space and select the appropriate parameters they wish to use.

Secondary indicator 1.4 ☺ *Wastewater treatment* **(Currently in use by the Commission on Sustainable Development)**	***Relevant targets*** **Main target - 8** **Additional targets – 4, 5, 14**

Justification
Pollution from waste water has a major impact on inland water and coastal ecosystems (as well as human health).

The indicator is already in use. No direct indicator work required. The opportunity is to develop relevant biodiversity storylines using ancillary information and analysis.

Wastewater effluents can result in increased nutrient levels, often leading to algal blooms; depleted dissolved oxygen, sometimes resulting in fish kills; destruction of aquatic habitats with sedimentation, debris, and increased water flow; and acute and chronic toxicity to aquatic life from chemical contaminants, as well as bioaccumulation of chemicals in the food chain. This indicator assesses the potential level of pollution from domestic and industrial/commercial point sources entering the aquatic environment, and monitors progress towards reducing this potential within the framework of integrated water resources management.

The indicator assesses the proportion of wastewater that undergoes different (primary, secondary and tertiary) levels of treatment. It includes the volume of wastewater treated at public wastewater treatment plants, industrial wastewater treatment plants and by independent wastewater treatment systems.

This indicator has important linkages to *Water Scarcity* (indicator 2.1 below), *Water Use Intensity by Economic Activity* (indicator 2.2 below), Biochemical Oxygen Demand (BOD) in Water Bodies and Concentration of Faecal Coliform in Freshwater (both water quality metrics), Population Growth Rate, Generation of Waste and Population with Access to Safe Sanitation (MDG target 7 c).

Storyline
Strategic Plan and CSD have a common direct interest.

Metrics/data availability

Already in use by the Commission on Sustainable Development. Further information and detailed methodologies available at:

http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/freshwater/waste_water_treatment.pdf

The metric is proportion of wastewater that is treated, in order to reduce pollutants before being discharged to the environment, by level of treatment (expressed as - percentage of volume of generated wastewater treated by primary treatment, secondary treatment, tertiary treatment or not treated).

Methodologies on data generation are recommended in the Data Collection Manual for the OECD/Eurostat Joint Questionnaire on Inland Waters Tables 1 – 7 (version 2.0) of Eurostat (2006) and the United Nations Statistics Division (UNSD) International Recommendations for Water Statistics (2008).

The lead agency is the United Nations Statistics Division.

UNEP are also engaged in interpreting the data and trends with regards to environmental aspects. UN-Water has an operational task force on waste water, led by UNEP, currently including assessing this topic for UNCSD 2012.

Constraints
This indicator provides information about wastewater volumes generated by point sources but not about wastewater volumes generated and discharged by diffuse sources. Storylines on the latter can however be obtained from additional indicator metrics under "water quality" combined with other information on non-point source pollution noting it is important to capture this aspect particularly in relation to agriculture under target 7.

Secondary indicator 1.5 ☺ *(a) Proportion of cities obtaining water supplies from protected areas; and/or* *(b) Proportion of protected areas established and managed primarily to protect water supplies.*	***Relevant targets*** **Main target - 11** **Additional targets - 14**

Justification
A key service provided by protected areas – and one of the main reasons for their establishment and management.

Significant resonance with cities/urban authorities.

Included with a smiley face because it is a central ecosystem service regarding target 11.

Storyline
Protected areas provide essential services.

Metrics/data availability
The two sub-indicators (proportion of cities; proportion of protected areas) are related and to some extent different ways of expressing the same topic (role of protected areas in water supply).

Metrics as stated.

Published figures for (a) are available but not (as far as is known) currently in a form that can be used for longer-term monitoring. Some data are quoted in Blumenfeld et al. 2010; more in Mulongoy and Gidda (2008). These sources confirm a significant relationship.

For (a) and (b) the WCPA Protected Areas database needs to be explored for information availability relating to the purpose/benefits of the protected areas established. Likewise the Ramsar Site Information System contains information on the purpose of these protected areas. Protected Areas specialists and cities/biodiversity groups (e.g., ICLEI) could be engaged to generate the metrics. Ideally, these metrics would be accompanied by a metric for economic value of this ecosystem service provided by protected areas (which is known to be high based on case studies).	
Constraints Indicator not yet fully developed – but it would be feasible to develop it. To be fully comprehensive, ideally, the metric should also capture areas managed for water supply but not formally protected. For example, broader catchment management/protection, and PES schemes in operation, etc.	
Secondary indicator 1.6 *Area of wetland used in water treatment (including both natural and constructed wetlands)*	***Relevant targets*** **Main target - 14** **Additional targets - 8**
Justification Directly related to using or enhancing ecosystem services. The water treatment in question could relate to either (i) producing clean water, for example, for drinking (provisioning), and/or to reduce pollution loads to below critical levels (regulating and supporting services).	
Metrics/data availability In need of development.	
Constraints Data availability may be an initial problem.	
Secondary indicator 1.7 *Access to improved drinking water based on change in water quality*	***Relevant targets*** **Main target - 14** **Additional targets**
Justification This is a potentially powerful indicator which addresses the need to disaggregate the relationship between drinking water supply and the contribution of ecosystems to it identified for indicator 1.1 above (referring to MDG target 7c, indicator 7.8). This indicator is under consideration and development by the UNCCD for this very reason.	
Metrics/data availability UNCCD (2011) refers to an available LADA-WOCAT (World Overview of Conservation Approaches and Technologies) methodology that has the potential to address safe drinking water access from the perspective of changes in water quality relative to overall water supply. In the LADA methodology, the survey of water degradation is an assessment of level of water resources, depth of water resources, water use, water withdrawal/extraction (and therefore many elements of indicator 2 below), as well as groundwater and surface water quality obtained through observations and measurements of water bodies in the field. There are currently issues with data availability and interpretation. UNCCD (2011) discusses this indicator in more detail. It is flagged here as an important indicator under development by other stakeholders.	
Constraints Currently not operational at regional or global scales.	

(2) Key ecosystem service 2 – water availability (regulation)

Primary indicator 2: water availability/water security ☺

Justification:

The sustainable availability of water in appropriate quantities for both ecosystem and human needs is a key ecosystem service. This is essential to meet both ecosystem (and biodiversity) needs and the requirements for direct and indirect human uses. A key requirement for sustainable development. A key requirement to support all other services derived from wetland and terrestrial ecosystems, and a key factor in determining coastal ecosystem functioning.

Water is the key resource in terms of sustainable consumption (target 4), a key factor in habitat loss (target 5), a key criterion in sustainable land use practice (target 7), a determinant of pollution loads through dilution effects (target 8), the key area for adaptation responses to climate change and essential for ecosystems to store carbon (targets 10 and 15), is a key service provided by protected areas (target 11) and is probably the most essential ecosystem service (target 14). The absence of water is also the descriptor and direct driver of desertification and its retention or restoration in ecosystems the basis of directly combating desertification (target 15).

Storyline:

Ecosystems drive water availability through regulating the water cycle. Changes in water availability, through direct use, impact ecosystem functioning and service provision. Equally, changes to ecosystems (e.g., land-cover impacts on evapotranspiration, land-use practice impacts on soil moisture) affect the availability of water. Biodiversity needs to be managed in order to sustain water availability (underpin the water cycle). Regulating the long-term absolute availability of water and extremes in hydrological extremes (floods and droughts) are key roles of biodiversity in supporting these ecosystem services.

Climate change impacts ecosystems mainly through changing hydrological regimes (average and extremes in precipitation and humidity) – and is an additional driver of hydrological change to direct anthropogenic water use or other ecosystem change (e.g., land use).

Water availability (more popularly framed in terms of water security) is widely recognized as the key global natural resource challenge. Much effort is devoted to monitoring and regularly assessing this topic – largely in human development terms. The storylines developed through the Aichi Biodiversity Targets and their indicators need to articulate the role of, and trends in, biodiversity and ecosystem services in this wider political, economic, social and development context. This would include both the contribution of biodiversity (ecosystems) to meeting water security needs and the impacts of water use on biodiversity.

Secondary indicator 2.1 ☺ *Water scarcity* Presented as "*Proportion of total water resources used*" (as per the Commission on Sustainable Development)	***Relevant targets*** **Main target - 4** **Additional targets – 5, 7, 8, 11, 14, 15**
Justification A key concern regarding sustainable development. In 2030, 47 per cent of the world population will be	

living in areas of high water stress (OECD 2008); Vörösmarty et al. (2010) calculate that already 80 per cent of the global population lives in water insecure areas. Very high relevance to the Strategic Plan and high political, public and business, etc., interest.

Metrics/data availability

Very extensive, with a long time series and in existing use. The key dataset is FAO AQUASTAT.

There are various existing methods of calculating and expressing this indicator, most of which are based on data on direct human use of water (including by the sectors, e.g., agriculture) as a proportion of the total annual renewable water resources available. This is usually expressed as Total Water Abstraction/Total Renewable Water Resources (TWA/TRWR). This can usually be disaggregated by country, region, sector use and source of the water, in particular surface *versus* groundwater.

For consistency, and in particular to build resonance, with other processes it might be useful to use the formulation of this indicator in use by the Commission on Sustainable Development as: *"Proportion of total water resources used";* although "water scarcity" has more resonance with the public.

A fact sheet and methodology is available at:
http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/freshwater/total_water_resources_used.pdf

The purpose of this indicator for the CSD is to show the degree to which total renewable water resources are being exploited to meet the country's water demands. It is an important measure of a country's vulnerability to water shortages, hence probably more obviously relevant to target 4. The indicator's interpretation benefits from linkages with other established water vulnerability indicators, such as freshwater resources *per capita*, measures of the country's economy, such as Gross Domestic Product (GDP) (or by industry), and poverty incidence as an indicator of equity of access. The indicator also needs to be matched with population, social and economic indicators, irrigation as a percentage of arable land, and drought frequency. Interpretation will benefit from linking this indicator with groundwater reserves and unused buffer water resources.

The indicator was included in the revised MDG monitoring framework, presented in 2007 to the United Nations General Assembly to monitor the Millennium Development Goal No. 7 (Ensure environmental sustainability) and the associated target: “Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources”. It is therefore already considered to be a key indicator of ecosystem services.

The FAO AQUASTAT dataset for this indicator is calculated regularly by the FAO as "*Water resources by country/territory and by inhabitant, and MDG Water Indicator (indicator MDG 7.5)"* at: http://www.fao.org/nr/water/aquastat/maps/AQUASTAT_water_resources_and_MDG_water_indicator-March_2009.pdf

There is already ongoing, extensive and regular monitoring and reporting on this indicator and in various ways by a number of agencies reflecting a range of resource, economic, policy and human development interests.

Subsets of the metrics for this indicator can include considerations of the sustainability of surface water and groundwater.

Key datasets are maintained by FAO AQUASTAT and the United Nations Statistics Division (UNSD), where they are a key element of national accounts.

The Strategic Plan indicator process can therefore just adopt this indicator – and then specialists can concentrate on reporting on the ecosystem/biodiversity storylines associated with it.

Constraints

This indicator has several important limitations, as noted in the above-mentioned fact sheet, most of them related to the computation of *total renewable water resources.* Seasonal variation in water resources is not reflected. This is however an opportunity for biodiversity storylines, since ecosystems play a key role in regulating seasonal availability (primarily through water storage and regulating precipitation), a topic captured by some other indicators and metrics proposed below.

There is no consideration of distribution among uses and policy options for mitigating scarcity, for example, re-allocation from agricultural to other uses (although allocations are reflected in the indicator "Water use intensity by economic activity"). Likewise, this is a storyline opportunity due to the role of ecosystems in mitigating scarcity.

Total renewable water resources do not consider water quality and its suitability for use; although this is captured under the above indicators for "clean water" etc.

Secondary indicator 2.2 ☺ *Water use intensity by economic activity* **(Also currently in use by the Commission on Sustainable Development)**	***Relevant targets*** **Main target - 4** **Additional targets – 7, 14, 15**

Justification

This indicator measures the intensity of water use in terms of volumes of water per unit of value added. It is an indicator of pressure of the economy on the water resources and therefore an indicator of sustainable development. It is an important indicator for policies of water allocation among different sectors of the economy since in water-scarce regions, where there is competition for water among various users, water is likely to be allocated to the less intensive use.

When this indicator is monitored over time, it shows whether the country manages its water resources to improve economic performance while simultaneously reducing the impact on the environment, that is, to decouple the pattern of water use from economic growth. Water conservation policies aiming at improving water intensity (through, for example, recycling and better water-saving technologies) ultimately reduce pressure on the environment.

A decrease in the value of this indicator may indicate: (a) improvements in technological efficiency; (b) structural changes in the economy with water allocated to less intense activities; (c) increased reuse of water in the economy; and (d) use of alternative sources (e.g., desalinated water). Water-use intensity is defined in a similar way as the indicators on material and energy intensity. It could also be expressed as ‘water-use productivity’ (the inverse of water intensity).

This indicator is linked to TWA/TRWR (above). While the indicator of annual abstraction measures pressure on the water resources, the water intensity indicator measures the water requirements of an economic activity (cubic metres of water per unit of value added generated) thus the pressure of the economy on the water resources. Together these two indicators form the basis for water allocation policies. This indicator can also be linked to social indicators, such as employment by economic activity, to evaluate the social impact of different allocation policies.

Currently this indicator is used largely to express formal economic values, in particular of provisioning ecosystem services (food production, hydropower, etc.). The opportunity here is to build storylines about the economic values of less formal economic benefits in particular with regards to regulating and supporting services provided by ecosystems (the dimensions of some of these are captured elsewhere in this note). This link also provides opportunities to build on storylines regarding water, green economies and ecosystems.

Storylines
Resonance with other stakeholder interests. Entry point for emphasising the role of water in the context of regulating and supporting services in addition to provisioning services. The interests of the Convention on Biological Diversity and economies are aligned. Biodiversity, economics and people share a common fate regarding water use.

Metrics/data availability
Currently in use by the Commission on Sustainable Development:
http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/freshwater/water_use_intensity.pdf

Cubic metres of water used per unit of value added (in US $) by economic activity ($m^3$/US$).

The lead agency is the United Nations Statistic Division (UNSD). At the national level information on value added is part of the official national accounts statistics collected by UNSD and can be found in the UNSD publications *National Accounts Statistics: Main Aggregates and Detailed Tables* and *National Accounts Statistics: Analysis of Main Aggregates.* Data on water use by economic activities are collected by two questionnaires on water: the UNSD/UNEP Questionnaire which covers non-OECD countries and the Joint OECD/Eurostat Questionnaire which covers OECD countries. The indicator is monitored and reported on an ongoing basis.

Constraints
The indicator (in combination with others) is a key indicator for assessing water use, its impacts and efficiency and shifts in policies. But a key requirement is however to obtain better economic data on the values of water for non-formal benefits in order to generate a more comprehensive biodiversity storyline. In the short term this will be difficult. Storylines can still be developed, including based on case study evidence. Recognition of the importance of such storylines should however stimulate longer-term interest and improvement in economic valuation approaches (and data) regarding water use.

Secondary indicator 2.3 ☺ *Human and economic losses due to natural disasters* **(Also in use by the Commission on Sustainable Development)** **A more specific construct of the indicator for current purposes would be: Human and economic losses due to water-related natural disasters**	***Relevant targets*** **Main target – 14** **Additional targets – 4, 10, 15**

Justification

High resonance with social, economic and political interests. The ability of ecosystems to regulate extreme water-related events (in particular flooding and drought) is a major ecosystem service/benefit. This applies in particular to wetlands but also land cover. Key water-related impacts are obviously flood, including floods as the main cause of losses from storms, and drought. Land-slide related disasters could also be included since they are generally caused by loss of soil functions/stability, including as caused by land cover changes, are often stimulated by extreme water-related weather phenomena and the impacts are often transferred downstream by water run-off.

Paragraph 42 of decision X/28 “notes the role of biodiversity and ecosystems in providing services that reduce vulnerability to the impact of some natural disasters, in particular water-related impacts such as flooding and drought, and that current global changes are anticipated to increase disaster vulnerability and risk.” Document UNEP/CBD/SBSTTA/14/INF/3 provides further background information including noting the high economic aspects of this topic (e.g., by some accounts natural disasters account for a sustained reduction of 14 per cent in GDP of low income countries with single disaster events accounting for a loss of up to 38 per cent of GDP). The report also notes that probably the majority of the impacts of most natural disasters are water-based.

Using more explicit biodiversity terminology, the same indicator could be expressed as "trends in loss of water-related disaster risk reduction ecosystem services" (which is the relevant storyline). But there is a case to maintain the actual indicator descriptor to maintain resonance with these other processes/interests.

The topic involves two aspects: (i) the role of ecosystems in reducing risks and vulnerability to disasters (reducing the frequency and severity of their occurrence); and (ii) the role of ecosystems in post-disaster vulnerability. The first is the key focus of the current indicator.

Although the current attention by the CSD refers to developing country contexts, it is notable that developed countries have the same problems and needs, which are also significant: for example., the missed opportunities to point out that much of the impacts of Hurricane Katrina on New Orleans, are attributable to lost ecosystem services, in particular wetland functions but also the loss of soil transport and deposition services (Batker et al. 2010).

This topic is also now one of the most prominent drivers of policy change towards ecosystem restoration. Emblematic examples include shifts towards restoring wetlands functions as a more cost effective and sustainable approach to flood mitigation.

Based on the experience of the International Decade for Natural Disaster Reduction, the United Nations General Assembly adopted resolution A/54/219 which established a permanent mandate for the United Nations system in the field of disaster reduction, in the framework of the global programme named the International Strategy for Disaster Reduction (ISDR)

Storylines

Biodiversity directly protects people from death, injury and significant economic loss

Metrics/data availability

Already in use, and being refined, for the Commission on Sustainable Development. Further information available at:
http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/natural_hazards/human_econ_loss.pdf

The metrics are the number of persons deceased, missing, and/or injured as a direct result of a disaster involving natural hazards; and the amount of economic and infrastructure losses incurred as a direct result of the natural disaster (number of fatalities, US$). For current use the metrics/datasets would ideally need to be disaggregated for water-related disasters and losses.

The data sets include: onset date, declaration date, disaster type (e.g., earthquakes, cyclones, floods, volcanic eruptions, drought, and storms – which allows disaggregation by water-related events), country, fatalities and estimated amount of damage.

The main dataset is maintained by The International Disaster Database (EM-DAT)[11]. The lead agency is the Secretariat for the International Strategy for Disaster Reduction (ISDR), United Nations, Geneva. The following agencies have been involved in indicator development: The Centre for Research on the Epidemiology of Disasters (CRED), the Faculty of Medicine, University of Louvain, Belgium, the World Food Programme (WFP), the United Nations Environment Programme (UNEP), the Pan American Health Organization (PAHO), the International Federation of the Red Cross and Red Crescent Societies (IFRC), the United States Agency for International Development (ISAID), and the ICSU – International Council of Scientific Unions, Munich Reinsurance Company.

A second related indicator is Percentage of Populations living in Disaster Prone Areas (see indicator 2.4 below). This, and the current indicator, could be combined as subsets (metrics) of a headline indicator.

A strong storyline can already accompany this indicator based on knowledge of trends in biodiversity, related ecosystem services, ecosystems, etc., using other indicator sets for the Aichi Biodiversity Targets and secondary sources of information. Ideally, additional indicator work in this area should look into supporting additional biodiversity-based messaging for this indicator and in particular further illuminating the links between ecosystem service loss, or gains (restoration), and disaster frequency and extent. Some promising areas might be as follows (some of which are already or could be used or developed for other purposes):

Trends in wetland extent – in particular mangroves and floodplains.

Trends in wetland restoration – in particular mangroves and floodplains.

Economic investments in wetland restoration.

Costs of investment in water-related risk reduction (capital and operational) – for artificially engineered solutions (currently the norm), which is a reflection of the costs of loss of natural infrastructure services.

Trends in insurance premiums - insurance premiums track risk. Insurance companies have some of the best developed economic and demographic data, indicators and analysis capacity. Data are available for all OECD countries, possibly poor data for developing countries – although this should not be presumed. It should include trends in refusal to offer risk insurance (that is – the highest perceived risk level). The insurance industry has high interest in both urban and rural sectors – including a large involvement in tracking insurance risks to agriculture. Drought risk insurance for farmers, including in developing countries, is a prominent insurance industry area.

For droughts, related indicators for TWA/TRWR, soil moisture, climate moisture index, trends in land degradation and desertification etc. are also relevant.

Constraints
The methodology is in widespread use in both developed and developing countries although it is not yet standardized. To reflect changing risk, the measurement should be losses per unit of time per capita.

[11] http://www.emdat.be/

This is not possible without further development of the indicator methodology. There are a number of factors involved in determining trends in losses including infrastructure development (and its location), demographic change, ecosystem change and climate change. Storylines need to try to disaggregate these factors. However, full success in achieving this disaggregation is not a prerequisite to be able to tell the important stories.

Secondary indicator 2.4 *Percentage of population living in natural hazard prone areas* **(Also in use by the Commission on Sustainable Development)** **A more specific construct for the indicator would be: Percentage of population living in water hazard prone areas**	***Relevant targets*** **Main target – 14** **Additional targets – 4, 10, 15**
Justification As per indicator 2.3. Indicators 2.3 and 2.4 could be used as combined approaches to monitoring and storyline development for the Secondary indicator (impacts of water-related natural disasters)	
Metrics/data availability A second key indicator in current use by the Commission on Sustainable Development. For further information see: http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/natural_hazards/population_hazard_proneareas.pdf The percentage of national population living in areas subject to significant risk of death or damage caused by prominent hazards: cyclones, drought, floods, earthquake, volcanoes and landslides. The indicator may be calculated separately for each relevant prominent hazard. The risk of death in a disaster caused by natural hazards is a function of physical exposure to a hazardous event and vulnerability to the hazard. The indicator measures the risk at subnational scale by using historical and other data on hazards and on vulnerability. The subnational risk levels are then aggregated to arrive at national values. Measurement – percentage. As for indicator 2.3, flood and drought risk data are included. The overall number of people affected by disasters has been growing by 6 per cent each year since 1960. This trend is expected to continue primarily because of increased concentration of people and values in the areas exposed to natural hazards. But a second factor is in play which is increased risks to populations due to a loss of relevant ecosystem services (e.g., loss of flood mitigation services provided by wetlands). An additional factor would be climate change. This indicator is linked with many demographic indicators, including population growth rate (total,	

urban and rural) and percentage of population in coastal areas. It is also linked to most poverty indicators, as poverty is a major determinant of vulnerability. It is directly linked to the indicator on human economic losses due to natural disasters. Amongst these sources of information it should be possible to control for population density increases *versus* absolute increases in risks due to ecosystem change (probability of hazard occurring and extent of hazard impact).

The percentage of population living in flood-prone areas will be obtained by combining the area affected by the 100-year return period flood with population density data. For other hazards, the risk at a subnational scale can be measured by using historical and other data on hazards and on vulnerability.

A key database is also The International Disaster Database (EM-DAT). The lead agency is the Secretariat for the International Strategy for Disaster Reduction (ISDR), United Nations, Geneva. This methodology is being used by a the Disaster Risk indexing project of the United Nations Development Programme (UNDP) in partnership with UNEP-GRID; the Hotspots indexing project implemented by Columbia University and the World Bank, under the umbrella of the ProVention Consortium and the Americas programme of IDEA in partnership with the InternAmerica Developing Bank.

Storylines
As for indicator 2.3, the existence and use of this indicator is an opportunity to build biodiversity related storylines related to it. Comments for indicator 2.3 also apply regarding the need to build such storylines, and opportunities to do so using additional sources of information.

Constraints
Current technical constraints are discussed in the aforementioned information source. Vulnerability using 100-year flood/drought criteria will need to be reassessed as climate change is altering these parameters.

The key difficulty for current purposes lies in (i) disaggregating social/economic factors and trends in ecosystem services, and (ii) generating the right biodiversity storylines to support interpretation of this indicator. Irrespective of the degree of difficulty to address the latter need using biodiversity metrics it remains important to articulate the biodiversity storyline of this (and related) indicators.

Secondary indicator 2.5 ☺ *Land affected by desertification*[12] **(Also in use by the Commission on Sustainable Development)**	***Relevant targets*** **Main target – 14, 15** **Additional targets – 4, 7, 10**

Justification
Desertification is about changes in water availability.

Desertification is an important topic, such as the Strategic Plan (as well as being explicitly mentioned in it), and with regards to climate change and desertification interests (including the UNCCD). Much attention is obviously given to this, and related, indicators by UNCCD (2011).

This indicator is included under water-related indicators because that is what it is – desertification being

[12] Another, related, primary indicator "Land Degradation" (which includes land degradation beyond just desertification) is also under development by the FAO (and is already included in the indicator suite for the CSD). This needs to be considered further to assess if that indicator process/data set can also generate information on water loss/retention/restoration in areas beyond drylands (as well as being useful for other ecosystem service related topics, including as a general indicator for target 7).

a process defined by changes in water availability (more exactly soil moisture content). The indicator is relevant also to target 7 because unsustainable agriculture and forestry are drivers of desertification – more positively, adopting agriculture/forestry approaches which restore soil moisture levels is a key response option.

The indicator describes the extent and severity of desertification at the national level. It is being developed to be: (i) a measure of the state of the problem at any one time; (ii) an indication of the trend in the severity of the problem over time and success of response mechanisms; and (iii) a means of comparing the severity of the problem from one country to another.

For dryland areas, desertification is a central problem in sustainable development. While many dryland ecosystems have generally low levels of absolute productivity, maintenance of that productivity is critical to the present and future livelihood of many hundreds of millions of people. "Productivity" refers to ecosystem services. The indicator is therefore closely ecosystem service related. In addition, soil biodiversity plays a key role directly in the maintenance of soil functions, including water retention, (hence combating desertification), as well as land cover (e.g., agricultural and forestry practice), together with wetlands, in sustaining surface and groundwater availability in drylands (as elsewhere). There are therefore significant biodiversity storylines within this indicator.

Storylines

Desertification is about water. Biodiversity is central to sustaining water on land to combat desertification.

Metrics/data availability

The amount of land affected by desertification and its proportion of national territory (area, Km^2 and % of land area affected).

This indicator is currently in use and being further developed/refined for, *inter alia*, the Commission on Sustainable Development. Further information is available at:
http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/land/desertification.pdf

According to information available at the time of writing the methodology for this indicator is currently under revision in the context of the Land Degradation Assessment in Drylands (LADA) project implemented by the Food and Agricultural Organization (FAO) and partners. An update of the current status of this indicator is provided in UNCCD (2011).

The indicator is closely linked with indicators concerning land use, such as deforestation, use of marginal land, protected area as a percent of total land area, the population living below the poverty line, other trends in water availability, trends in sustainability of agricultural and forestry practice, and status and trends of wetlands etc.

The lead agency is the FAO through LADA. Other contributing organizations include: the UNDP Dryland Development Centre, UNEP, Consultative Group on International Agricultural Research (CGIAR), the International Fund for Agricultural Development (IFAD), and the World Soil Information (ISRIC).

This is a core impact indicator in use by the UNCCD (in different but related constructs, see section 0). UNCCD (2011) provides a much more comprehensive assessment of relevant indicators for land/use desertification.

Constraints
There have been some methodological and definition issues which are being resolved by the above stated agencies and partners. UNCCD (2011) discusses methodological issues in much detail.

Secondary indicator 2.6 *Water footprint*	***Relevant targets*** **Main target – 4** **Additional targets – 5, 7, 10, 12, 14, 15,**

Justification
A key indicator of pressures on resources is the amount of water used by various production and consumption activities. Whereas indicator 2.2 (water use intensity) reflects gross consumption of water by sectors, the water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business. Water footprints can be calculated by commodity or service, sector, per capita or by country. They can also factor in footprints on domestic water resources and impacts on other areas, through considering virtual water arising from trade. (e.g., Hoekstra and Chapagain 2008).

Like carbon footprints, water footprints are effectively a subset of ecological footprints derived by disaggregating impacts on water resources.

Metrics/data availability

Methodologies are described by Hoekstra et al. (2011).

The Water Footprint Network (http://www.waterfootprint.org/?page=files/home) monitors this indicator and continually improves methodologies and reporting.

Examples of indicator metrics already available at the national level (and being updated) include: water footprints of nations (1997-2001); Virtual water flows per country related to international trade in crop, livestock and industrial products (1997-2001); Water footprint *versus* water scarcity, self-sufficiency and water import dependency per country (1997-2001); National water savings and losses due to trade in agricultural products (1997-2001).

Constraints
Methodologies are not perfect but are continually improving. Interpretation of water footprints requires knowledge of water resources availability in the area of consumption (or supply). It is therefore a relative indicator that is best interpreted along with other data (e.g., water scarcity). A major consideration is that national data can disguise regional and local differences – which can be significant in countries with very uneven water resources availability and consumption patterns.

Secondary indicator 2.7☺ *Soil moisture*	***Relevant targets*** **Main target – 14** **Additional targets – 15, 11, 7, 4**

Justification
Soil moisture is a critical factor in maintaining most terrestrial ecosystem functions. Loss of sustainable levels of soil moisture is a major cause of ecosystem degradation driven by a combination of factors including land cover (vegetation) changes, land management (e.g., tillage in agriculture, drainage and chemical use). It is also the single direct determinant of desertification.

Soil moisture is a key determinant of agricultural productivity and sustainability (net primary productivity).

Changes in soil moisture can be regarded as a driver (pressure on) biodiversity and ecosystem functions (e.g., indicator for target 4). Notably though, maintaining the water retention properties of soils is a key regulating/supporting ecosystem service and one underpinned directly by biodiversity. Animals, plants and micro-organisms in soil (and that associated with land cover) create and maintain conditions enabling water to be captured and retained. The water retained is not only a resource needed directly by soil and terrestrial biodiversity but its sustained presence is required to support soil functioning and in particular nutrient cycling and availability and carbon storage. For this reason it is proposed that this indicator be more directly associated with target 14. In addition, soil moisture, together with surface and groundwater water scarcity, is a key factor regarding sustaining efforts towards target 15 – without adequate soil moisture terrestrial ecosystems (vegetation) will not sustain carbon storage.

This indicator is also attractive because it builds more explicit links to soil biodiversity, a very important ecosystem component, and a topic so far lightly covered explicitly in the Strategic Plan and the Aichi Biodiversity Targets.

An important subset of soil moisture considerations would be trends in moisture levels (including inundation/wetting) in carbon-rich soils, in particular peatlands.

Soil moisture levels are also related to the regulation of surface water availability including extremes in excess water (flooding) since soils are a key natural store (regulator of water supply) and a factor in controlling soil erosion and soil related disasters (such as landslides).

Soil moisture, as a supporting/regulating service, is therefore proposed to be the focus of the indicator, whereas available direct measures of biodiversity as such (soil biodiversity metrics, land cover, etc.) are not direct measures of this ecosystem service. Information on the latter, however, would be beneficial in developing storylines about the role of biodiversity, and consequences in trends in its loss, on water availability in soils and associated impacts on ecosystem services.

The indicator is closely related to, and supports, indicators for water-related causes of land degradation and in particular desertification (indicator 2.5).

Storylines
Soil biodiversity/functions underpin water availability in soils and are impacted by changes in soil moisture content. This is a key variable determining land productivity, including the entire world agricultural production, and water cycle regulation (including disaster risks, especially drought).

Metrics/data availability
There is currently no standardized global monitoring and reporting process for this indicator but it is anticipated that one may soon be available.

There are various methods for measuring soil moisture levels including direct measures using soil probes, which are accurate but with limited coverage at larger scales, modelling using other hydrological data and remote sensing (discussion is provided by for example Reichle et al. 2004). There is however much interest in improving methodologies and coverage due to the importance of the subject for land productivity, hydrological modelling and climate change, particularly more recently through the application of remote sensing to overcome the problems of scale.

The current series of European Space Agency water missions is next in the series of Earth Explorer missions, which are designed to observe critical Earth system variables. Launched on 2 November 2009, the Soil Moisture and Ocean Salinity (SMOS) satellite is the first satellite dedicated to providing global measurements of soil moisture and ocean salinity.[13] The amount of water in the soil and the salinity of the oceans are both key variables linked to the global water cycle. Variations in soil moisture and ocean salinity are a consequence of the continuous exchange of water between the oceans, the atmosphere and the land – Earth's water cycle, which not only sustains life on Earth but also plays an important role in weather and climate. Data from SMOS will fill the current lack of global and continuous observations of soil moisture and ocean salinity needed to improve our understanding of Earth's water cycle. This will help understand more about how a changing climate may be affecting patterns of evaporation over the land and oceans. Data from SMOS could improve weather and climate models, and have practical applications in areas such as agriculture and water resource management.

SMOS will provide global information on surface soil moisture every three days with 4 per cent accuracy at a spatial resolution of 50 km. As a secondary objective, SMOS will also provide observations over regions of snow and ice, contributing to studies of the cryosphere. More details are available at http://esamultimedia.esa.int/docs/SMOS/SMOS_factsheet_22Jun09.pdf.

The FAO AQUASTAT database, although containing limited data on direct measurements of soil moisture, contains data on deliberate removal of it through the dataset on: "Non-irrigated cultivated area: part drained". This is defined as area cultivated and not irrigated, where drainage is used to remove excess water from the land surface and/or the upper soil layer to make humid/wet land more productive. A distinction should be made between drainage in humid countries and drainage in semi-arid countries. In humid countries, it refers mainly to the areas which normally are flooded and where flood mitigation has taken place. A distinction could be made between pumped drainage, gravity drainage and tidal drainage. In semi-arid countries, it refers to the area cultivated and not irrigated where drainage is used to remove excess water from the land surface and/or upper soil layer to make humid/wet land more productive. It also contains similar data for drained cultivated areas (which includes the latter and drained irrigated areas).

A related indicator is extent of **Conservation Agriculture (CA)** – data on which is maintained by FAO AQUASTAT. One of the key goals of conservation agriculture is to restore biodiversity and soil functions and in particular water retention (soil moisture). CA is an agricultural practice whereby the disturbed area is be less than 15 cm wide or 25 per cent of the cropped area (whichever is lower). AQUASTAT distinguishes between 30-60 per cent, 61-90 per cent and 91 per cent ground cover. Ground cover must be measured after planting time. Ground cover less than 30 per cent is not considered CA. Rotation must involve at least 3 different crops. Rotation is not a requirement for CA at this time, but AQUASTAT reports whether rotation is being carried out or not. An indicator "Extent of Conservation Agriculture" is therefore relevant to water availability/water security related ecosystem services (sub-category – soil moisture) but also of particular use regarding target 7.

Since soil moisture is a central factor regarding desertification and land productivity the UNCCD (UNCCD 2011) has devoted much attention to this. Currently the approach uses a number of relevant indicators and metrics to reflect water availability to soils – although currently no direct measure (soil moisture).

Constraints
An accurate and consistent set of data across various direct assessment methods is not currently available for global baselines – although there are better datasets at a smaller scale. The indicator can be

[13] Ocean salinity, derived by the same satellite, is also a potentially useful data source, indicator and monitoring process regarding water and marine and coastal areas.

regarded as under development although the importance of the topic, interest in it and resources being made available, give a high level of confidence that useful global or at least regional models and datasets will soon be available. There is high confidence that current scientific interest will be exploring elucidating trends derived from historical data.

Soil moisture levels are influenced by climatic variation – both natural and anthropogenic, including variations in precipitation, humidity and temperature. Ideally it would be useful to disaggregate climate influences and land and water use/management practices. UNCCD (2011) devotes much attention to elucidating such storylines based on numerous related metrics including trends in precipitation, land use and land cover change. Even if this cannot be achieved in the short term, trends in soil moisture, no matter the cause, are still a major driver of changes to soil functions, biodiversity and ecosystem services.

A key requirement, and probably a constraint, will be to get remote sensing, hydrology, land management and soil biodiversity specialists working together to generate the necessary storylines regarding relevant trends in ecosystem services.

Secondary indicator 2.8 ☺ *Climate moisture index (CMI)*	***Relevant targets*** **Main target – 14** **Additional targets – 4, 5, 7, 10, 11, 15**

Justification

The amount of water contained in the atmosphere is both a critical ecosystem service and driver of ecosystem degradation. In most land areas there are two primary and inter-related variables – precipitation and plant transpiration. Rainforests or humid forests are, for example, defined by, and sustained by, a high value for this indicator. A sustained drop in CMI would lead to a shift of forest type from humid to dryland; *vice versa* deforestation can be expected to reduce the CMI locally and regionally. Other types of land cover, including agricultural crops, play a similar role.

The CMI is an important indicator of reliable water supplies for both ecosystems and people. The indicator also addresses the need to capture the fact that the water cycle involves not only precipitation, surface, groundwater and soil moisture but also potential changes in humidity through plant transpiration.

There is an intimate relationship between CMI and soil moisture (indicator 2.7).

The UNCCD has adopted the indicator “Aridity Index” (following a similar Aridity/Bioclimatic Index) of UNEP, which is the same as the CMI, being based on the same dataset and methodology (UNCCD 2011).

Storyline

Biodiversity underpins climate moisture through evapotranspiration (the release of water into the air through plants).

Metrics/data availability

The indicator is based on the following definition: the ratio of mean annual precipitation and mean annual evapotranspiration. The CMI ranges from –1 to +1, with wet climates showing positive values and dry climates negative values. As important as the baseline CMI is its variability over multiple years.

It is not a direct measure of humidity but an indicator of it.

The data for the indicator are partially derived from the water accounts whereas precipitation is recorded in the asset accounts maintained by the UNSD. The asset accounts record actual (and not potential) evapotranspiration. Related datasets are maintained by FAO AQUASTAT and the World Meteorological Organisation (WMO).

This is regarded a key indicator for which there is an indicator profile sheet and statistical data (United Nations 2006).

To be able to tell meaningful biodiversity storylines associated information on relevant changes in biodiversity needs to be factored in. This would include, for example, trends in land cover (particularly deforestation, condition of grasslands and agriculture expansion and crop use), soil moisture, desertification and carbon storage.

An indicator addressing a related topic is work on indicators for the "greeness trend" of land: in other words, the relationship between land cover (biodiversity), land status, water availability and net primary productivity (as a proxy for ecosystem services). This is not a direct measure of CMI but reflects the interface between rainfall availability, evapotranspiration and land cover and its status. See section 0 for further details.

Constraints

There are some difficulties in interpretation considering other variables are in play including climate change (both natural and anthropogenic). To be of most use the data needs to be expressed by region or subregion, usually by major river basin. Global values are of limited use since decreases in the index in one region can be offset by increases in another.

*Secondary indicator 2.***9** ☺ *Extent of terrestrial carbon storage vulnerable to water insecurity*	***Relevant targets*** **Main target – 15** **Additional targets – 14, 4**

Justification

Water security is a key requirement to safeguard carbon storage by terrestrial (and wetland) ecosystems. Negative changes in soil moisture, climate moisture, precipitation and groundwater negatively impact the ability of ecosystems to store carbon.

Included would be carbon storage in carbon rich soils (particularly peatlands) – loss of water from these areas (through e.g., drainage) being a major driver of significant loss of carbon storage.

This is a simple integrated indicator combining two other indicators – above and below ground carbon storage (see section 0) and water availability (scarcity) and is useful to draw attention to the linkages between the carbon and water cycles.

Storyline

Biodiversity underpins water availability which is required to sustain carbon storage ecosystem services. The carbon and water cycles are linked and must be managed together.

Metrics/data availability

Relevant data are available from (i) various water resources availability/distribution data (as above), and (ii) carbon storage data (not included here but already an area of focus for the Aichi Biodiversity Target indicators). Both are currently being significantly improved through recent remote sensing data.

An important subset of metrics would be *proportion of REDD investments in water insecure areas*.

Constraints

As per the underlying indicators.

Secondary indicator 2.10 *Trends in number of water related conflicts and number/magnitude of inter-state conflicts*	***Relevant targets*** **Main target – 14** **Additional targets –**

Justification
A potentially useful indicator to draw attention to the gravity of potential water-related ecosystem service conflicts – thereby drawing attention to the benefits of improved ecosystem management (or costs of not doing so).

The Aichi Biodiversity Targets do not currently adequately address relevant needs to promote international cooperation despite the existence of relevant articles to this effect under the Convention itself. Cooperation regarding inland waters biodiversity and water-related ecosystem services being probably the most notable and important needs in this regard because of their transboundary nature.

There are a great number of inter-state and national conflicts over water. Emblematic, and politically high profile examples include practically the entire Middle East. Two prominent countries with a long history of water conflict are India and Pakistan – both now nuclear armed powers. It would be a shame to miss out on the opportunity to point out that the Strategic Plan can make a contribution to reducing such conflicts through underpinning more sustainable water security.

Storyline
Sustaining biodiversity/ecosystem services is also about conflict resolution including avoiding violence and war.

Metrics/data availability

Information on this is included in the World Water Development Report Series.

The World Water Assessment Programme is currently developing the indicator *Number, frequency, magnitude of formal interstate conflicts* and *trends in number of water conflicts (national).*

A related indicator would be *number of transboundary water bodies/basins with cooperation agreements in force(managing political tensions regarding water resources)*

Constraints
Needing to be developed, but feasible. Water-related conflicts are complex and have a prominent political dimension. The storyline is that biodiversity is a relevant part of the subject – it would be naive to suggest it as the solution to the problem.

(3) Key ecosystem service 3 – sediment transfer (supporting service)

Primary indicator 3: sediment transfer ☺

A key service provided by ecosystems is in supporting sediment formation, transportation and deposition (sediment transfer). The process is very dynamic and involves both land and aquatic components of ecosystems. Indeed it is responsible for land formation itself, but the sediments are transported and deposited by water (usually via rivers). This is very much a hydrologically driven, and therefore water-related, ecosystem service. The service is largely based on biophysical processes in that biodiversity is directly involved in contributing to producing and regulating the sediments (both soil formation and functions and land cover regulating erosion), whereas sediments are moved and transported by more physical processes along rivers, but in fashions determined by ecosystem integrity, and when eventually deposited determine the functioning and extent of ecosystems and habitat.

Whilst sediment transfer greatly in excess of natural levels is usually undesirable, the maintenance of natural levels of sediment transfer is a critical ecosystem service. The reduction in sediment transfer, below natural levels, has very significant impacts on ecosystems and economies. For example, fully one-third of sediment destined for the coastal zones no longer arrives there due to sediment trapping and water diversion (Vörösmarty et al., 2003), with concomitant increases in the net erosion of sensitive coastal settings like deltas that require a steady supply of land-derived sediment (Ericson et al., 2006).

Without the input of sediment and water, wetland systems collapse. This includes associated considerations of land formation (sediment deposition) services provided by wetlands, in particular in river deltas and associated coastal regions. The movement of water and sediment underlies the production of many and significant economic benefits, including protection against natural hazards and producing or sustaining land. All deltas grow in some areas and deteriorate in others as the river deposits sediment in one lobe and then shifts sedimentation to another lobe. Natural subsidence of river deltas results from the compaction of loosely deposited sediments and dewatering: deltas constantly subside, sinking as sediment settles. However, the constant deposit of new sediments for thousands of years usually brings about a net gain of land and elevation. The elimination of sediment and water inputs from the river to a delta initiates the collapse of wetlands, pervasive changes in hydrology, coastal erosion and land loss. A similar process takes place with inland wetlands (e.g., river floodplains).

The importance of this topic in biodiversity, ecosystem, economic and human well-being is well illustrated by Bakter et al. (2010) in their analysis of the Mississippi River Delta. Sedimentation and wetland plant growth caused the Mississippi River Delta's net land expansion for thousands of years. However, its deterioration in the last 80 years showed a land loss as high as 24,710 acres per year or a total wetland loss of over 1.2 million acres. The land-loss rates were highest in the 1960s and 1970s due to rapid reservoir expansion (reservoirs trap sediments). Recent rates of loss were estimated before 2005 at 15,360 acres per year, still a high rate of loss, with a total expected loss of over 328,000 acres in the next 50 years. However, hurricanes Katrina and Rita may have rewritten the estimates of potential land loss. The United States Geological Survey estimated that 138,000 acres of land were lost to open water due to the 2005 hurricanes alone[14]. Healthy wetlands are often horizontally compacted by hurricanes only to re-expand after the storm. Similarly, storms can actually benefit wetlands by bringing additional sediment in from the continental shelf. However, if wetlands are unhealthy, as is largely the situation along the Mississippi coast, hurricanes can physically break them up or bring in saltwater.

[14] These estimates, for a single delta system, suggest that loss of natural habitat due to interruptions in sediment transfer and related hydrology globally could well be in the same order of magnitude as the current global rate of deforestation.

Bakter et al. (2010) conclude that restoring sediment transfer by allowing the Mississippi River to move vast amounts of sediment and water is far less expensive than constructing levees and pumping sediment to compensate for its loss. Their estimates of the economic value of this service are based on the fact that sediment transfer influences a number of specific benefits such as land formation, storm protection, etc., which are often valued separately. In order to indicate the scale of importance of this topic for current purposes, these authors estimated that restoring this sediment transfer service/function of the river results in net annual benefits of $62 billion (this includes partial values of 11 ecosystem services); this includes opportunity costs of redirecting water use and allocations. This is for only one delta, although a moderately large one[15]. For comparative purposes, the total value of global annual capture fisheries production (an ecosystem service) is only $93.9 billion (FAO 2010).

Importantly, urban expansion and coastal zone development is now leading to high human populations in deltas, many located in mega-cities there, and most are located in developing countries. The majority of these, if not all, are already vulnerable to the loss of this ecosystem service.

There has been previous attention to sedimentation as an indicator (or metric) for Convention on Biological Diversity targets. Sediment loads in water for example are usually a parameter amongst water quality metrics. But the approach has been to regard this largely as a direct driver of biodiversity loss (e.g., siltation of wetlands, or sediments as a component of water pollution). Likewise river fragmentation (i.e., dam building) is also already included in the Convention on Biological Diversity target indicator framework, as an indicator of ecosystem integrity, but without clear links to the ecosystem services which ecosystem integrity supports. This seriously understates the importance of this topic as an ecosystem service.

Storylines:

This ecosystem service is extremely important. Multiple storylines can be developed based on trends in the service itself and trends in associated factors, both from the perspective of drivers and benefits. Many of these would be built on related indicators. Some aspects of sub-storylines would include:

- Headline trends in sediment transfer – locally these can be positive (maintenance of ecosystem functions and desired service delivery, target 14) or negative (either too much or too little transfer, target 4); since the two scenarios can cancel each other out at the global level this storyline would likely be more useful when told at regional or subregional levels, and illustrated by individual river basin/delta case studies;
- Trends in relevant biodiversity at the species and population levels, in particular relevant trends in coastal biodiversity, for example estuarine bird populations or mangroves;
- Implications for relevant ecosystems (particularly delta/coastal systems but also relevant inland wetlands), including gains/losses in habitat area and quality;
- Trends in, and/or implications for, associated ecosystem services including ecosystem resilience, protection from/mitigation of extreme weather events, in particular flood risk/impacts and protection from storms, including indicators 2.3 and 2.4 (above), estuarine and coastal fisheries and tourism, including their relevant economic storylines;
- Trends in drivers arising from land management, such as sustainable land-management practices, in particular regulation of soil formation/erosion (particularly through improved agricultural practice which should be captured for other reasons for monitoring target 7);
- Trends in water use related drivers including in river hydrology (including most indicators for primary indicator 2 above) and river fragmentation (target 5), including dam construction/decommissioning;

[15] There are many much larger systems. For example, the Mississippi is only 7.5 per cent the size of the Amazon based on mean discharge.

- Relevant trends in forests, in particular regarding deforestation as a driver of soil erosion (and changes in hydrology), and trends in mangroves and ecosystem services they deliver (mangroves both contribute to and depend on sediment transfer/capture, and hydrology); and
- Trends in riparian buffer zones (vegetation cover along wetland margins, particularly rivers).

Primary indicator 3.1 ☺ *Sediment transfer*	***Relevant targets*** **Main target – 14** **Additional targets – 8**

Justification

It is difficult to overestimate the importance of this topic (as above) and therefore the need to capture it in monitoring for the Aichi Biodiversity Targets. Notably, this ecosystem service is conspicuously absent from previous discussions of ecosystem services and indicators for the Convention on Biological Diversity targets (both for the 2010 targets and for 2011-2020; BIP 2010, CBD 2011).

Despite some difficulties in metrics for indicators for this service, and interpretations of them, the conclusion is that capturing this subject in indicators for the Aichi biodiversity targets is a high priority.

Metrics/data availability

At the global level, the Convention on Biological Diversity has already provisionally defined an indicator area concerning biological oxygen demand (BOD), nitrates and sediments/turbidity (Conference of the Parties decision VIII/15); but as part of water quality. Sediments, that is the concentration of suspended solids in water, as a parameter of water quality, is an important aspect but sediment transfer considers not only the amount of solids water holds at any one time but the rates of uptake, transfer through the ecosystem and deposition and from where and to where this occurs. It is important to know if levels of transfer (and deposition) are above or below those necessary to support desired ecosystem functioning and service delivery.

Currently it is unclear whether there is adequate reporting on monitoring of this ecosystem service in a regular fashion easily compatible with the needs for the Aichi Biodiversity Targets. There are however much underlying data available that has been compiled by various assessments at local, regional and global levels. These include, for example, Walling and Fang (2003), Syvitski et al. (2005), Vörösmarty et al. (1997, 2003) and Ericson et al. (2006). The Hydrologic Engineering Center (HEC), an organization within the Institute for Water Resources, is the designated Center of Expertise for the US Army Corps of Engineers in river hydraulics and sediment transport and maintains computer modelling software for this topic. There is also a relatively high degree of knowledge regarding land management and its impacts on soil erosion, and hence on potential drivers of sediment loads. For example, Uri and Lewis (1999) provide estimates of erosion from United States cropland and Hu et al. (2008) likewise for erosion control measures in the Middle Yellow River Basin in China; Lal et al. (2004) and Montgomery (2007) give global overviews.

The FAO AQUASTAT database contains the dataset "*Global river sediment yields*". This contains data on annual sediment yields in worldwide rivers and reservoirs, searchable by river, country and continent. The database was compiled from different sources by HR Wallingford, UK, on behalf of the FAO Land and Water Development Division. Although this database has not been updated since 2000, it is maintained.

A related indicator *Sediment trapping efficiency index* refers to the residence time of water in large reservoirs and subsequent sediment trapping efficiencies are calculated as a measure of the impact of these man-made structures on the characteristics of river flow and sediment discharge to the ocean.

Estimations of water removed from basins as diversions (i.e., interbasin transfers and consumptive use) also provide information on the impacts of diversions on river flow and sediment transport. The data required are partially derived from the national water accounts whereas information on the annual discharge of dams is available from national asset accounts maintained by the UNSD. According to the United Nations (2006) this is a key indicator for which there is an indicator profile sheet and statistical data. These examples give confidence that suitable metrics are available although there is a need to clarify reporting mechanisms and indicator development needs if any.
Constraints An indicator, probably based on multiple metrics, may need to be further developed. This is a highly technical and specialized subject. Current data availability, monitoring and existing related indicators will need to be assessed and a system for compiling physical, hydrological, economic and other ecosystem metrics devised either as an integrated indicator or as a means for monitoring and reporting on relevant Secondary storylines using multiple metrics. A number of stakeholders currently involved in ongoing technical work on this subject do not use ecosystem services terminology. A lead agency for this indicator has not yet been identified although there are a number of well-established institutions/agencies working on relevant subjects.

(4) Key ecosystem service 4: energy (provisioning)

Energy is an important provisioning service provided by ecosystems (Millennium Ecosystem Assessment) and therefore justifies consideration for inclusion in the indicator/monitoring framework for the Aichi Biodiversity Targets. Both the direct and indirect uses of water are relevant. The first (direct use) relates primarily to hydropower. Indirect uses of water to produce energy include biofuels, the feedstocks of which require water to grow and water is also required in the production chain, and water used to support other energy production methods such as cooling for nuclear power generation (often a consumptive use of water through evaporation).[16]

Storylines:
Two relevant storylines centre on how biodiversity/ecosystems underpin energy production and are impacted by it. Both aspects are relevant and together form part of the basis for trade-off decision-making regarding ecosystem use. The role of biodiversity/ecosystems in underpinning water availability was explained above (primary indicator – water availability) and this applies equally to hydropower production. An improved understanding of the way in which ecosystems underpin hydropower is illustrated by, for example, emerging evidence of deforestation reducing water availability for hydropower generation.

The impact of the energy production on water and relevant implications for biodiversity and ecosystem services has a long record of assessment and monitoring (river fragmentation, for example, is in part driven by hydropower dam development).

[16] Biofuel is regarded as a sub-set of provisioning services provided through agriculture (and forestry). Relevant indicators are discussed under indicators 2.2, 2.6, 6.3).

Secondary indicator 4.1 *Actual hydropower installed capacity/potential capacity*	***Relevant targets*** **Main target – 14** **Additional targets – 4**
Justification A direct indicator of the ecosystem service (energy). There is also increasing evidence that ecosystem changes, for example deforestation, are undermining hydropower production – which generates more common ground between environment and hydropower interests.	
Metrics/data availability Data on hydropower development are maintained by the World Bank, usually by installed capacity (megawatts) and relative to potential hydropower capacity by country. Data can also be derived from water and energy accounts maintained by the UNSD. Consideration of this metric is also included, in part, under *Water use intensity by economic activity* (indicator 2.2 above). The related indicator *Capability of hydropower generation* refers to the gross theoretical capability and expresses the total amount of electricity which could potentially be generated, if all available water resources were turned to this use (that is, the potential ecosystem-service benefit). The technically exploitable capability expresses the hydropower capability which is attractive and readily available with existing technology. The economically exploitable capability is the amount of hydropower generating capacity which could be built. The indicators for these already exist for which there is an indicator profile sheet and statistical data (United Nations 2006). Data maintained by UNSD on energy accounts also allows the computation of *Electricity generation by energy source which* enables the measurement of the contribution of hydropower to electricity supplies over time as compared to other energy sources. *Storyline* Hydropower as an ecosystem service (and also a driver of biodiversity and ecosystem service loss). Since hydropower is based on water availability (indicator 2 above) its production is also underpinned by biodiversity.	
Constraints Hydropower has tended to be regarded in a negative light with regards to biodiversity. There may be resistance to including it as a benefit (ecosystem service). But if "biodiversity underpins all ecosystem services" (CBD 2011) then included it should be and by doing so will help to mainstream biodiversity into relevant sectors (hence also contributing to targets 1, 2, 3 and 19). A key issue with hydropower (although as with any other ecosystem service) is trade offs with other ecosystem services which has always been at the heart of the hydropower debate. Data on trends in hydropower production therefore need to be assessed with regards to trends in other services impacted (noting in particular in the current context the relevance of the "sediment transfer" indicator in this regard).	

(5) Key ecosystem service 5: - disease regulation[17]

Justification:
The burden of infectious diseases continues globally and in some areas has increased because of the emergence of new pathogens and the re-emergence of old pathogens newly resistant to current methods of control. Many of these are linked to wetland ecosystems as either water-borne or vector-borne pathogens (Horwitz *et al*. in press). The evidence however suggests that the prevalence of such diseases increases where wetland ecosystems become degraded.

Ultimate primary indicators that this storyline should communicate with include MDG Target 4a ("Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate"; indicators 4.1 Under-five mortality rate; and 4.2 Infant mortality rate) and MDG Target 6c ("Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases"- and its indicators). The reduction of child mortality is one of the most strongly and universally supported development goals. In high-mortality settings, a large proportion of all deaths occur before age 5. The latter indicator sets however do not currently allow disaggregation of data by cause of mortality, although related data sources shed light on this aspect. There is a case for referring directly to the aforementioned MDG targets although the link with biodiversity is more tenuous than for MDG target 7c.

Clean water (indicator 1 above) is also relevant, particularly the human disease related metrics of water quality. A related direct indicator can therefore be derived from some of the metrics used for water quality, in particular human pathogen loads.

Storylines:
The role of healthy ecosystems (wetlands) in regulating the incidence of diseases.

Constraints:
Supporting strong storylines is currently difficult based on current data/indicator availability. This is a complicated subject. Many variables are in play including socio-economic factors (e.g., access to health care) as well as degree of exposure to water-related health risks. Currently it is possible to draw some links. Various reviews and datasets indicate water-related diseases as a subset of human disease incidence. These give an indication of the high importance of water-related diseases but unless this can be assessed in relation to ecosystem change it can provide incorrect and negative messaging (e.g., “wetlands harbour mosquitoes therefore they are bad").

This ecosystem service and indicator area requires more work. It is not known if current knowledge and data availability are adequate.

Secondary indicator 5.1 *Population affected by water-related diseases*	***Relevant targets*** **Main target – 14** **Additional targets –**
Justification A key metric expressing the incidence of water-related diseases. This can be interpreted as an indicator of the loss of disease-regulation services (with prudent analysis).	
Metrics/data availability The indicator and its accompanying datasets are maintained by FAO AQUASTAT.	

[17] This section currently focuses on water-related diseases but is also relevant for regulation of other diseases. Consideration could be given to include these other disease aspects to capture the broader nature of disease regulation.

Three types of water-related diseases are recorded: (i) water-borne diseases are those diseases that arise from infected water and are transmitted when the water is used for drinking or cooking, for example, cholera, typhoid (data for risks to this are also captured under metrics for water quality); (ii) water-based diseases are those in which water provides the habitant for host organisms of parasites ingested (for example schistosomiasis or bilharzia); (iii) water-related insect vector diseases are those in which insect vectors rely on water as a habitat but transmission is not through direct contact with water (for example malaria, onchocerciasis or river blindness, elephantiasis). The WHO maintains data (and reports) on *relative importance of waterborne diseases in the total burden of diseases*. These can be disaggregated by diarrhoea (pertaining largely to water quality) and malaria (pertaining to habitat condition for vectors).
Constraints See above.

Secondary indicator 5.1 *Parasite loadings*	***Relevant targets*** **Main target – 14** **Additional targets –**
Justification Pathogens are essentially parasites, and parasites, vectors and hosts are integral components of aquatic ecosystems. If we take the hypothesis that the diversity and organizational aspects of parasite-host relationships regulates disease occurrence in aquatic communities (this is a recognized 'regulating ecosystem service'), then any change that leads to the simplification of parasite-host relationships in a community will provide a platform for the ability of infectious diseases to emerge or re-emerge. Simplifications include intensive agriculture associated with wetlands, over-predation or over-application of pesticides or antibiotics, or land degradation that result in increased exposures of people to vectors of diseases.	
Metrics/data availability Needing development. Use of parasite loadings (diversity, abundance) as an indicator of environmental degradation has been assessed by, for example, Marcogliese (2005). Further methods are presented by Jones et al. (2008) who note relevant applications at site level and subregional and global scales with datasets from 1940-2005. With regards to emerging infectious diseases (EID) they hypothesize that EID events caused by zoonotic pathogens from wildlife are significantly correlated with wildlife biodiversity, and those caused by drug-resistant pathogens are more correlated with socio-economic conditions than those caused by zoonotic pathogens.	
Constraints See above.	

(6) Water as it underpins other provisioning services (food, raw materials, genetic resources, medicinal resources, ornamental resources)

Previous assessments (BIP 2010, CBD 2011, and CBD decision X/7) have noted that ecosystem services indicators are best developed for the provisioning services. Water and energy (as provisioning services) are addressed above as are some aspects of the impacts of some provisioning services on water.

Provisioning services involving direct harvesting or farming aquatic biodiversity would be chiefly the products of fisheries and aquaculture, and regarding crops, in particular rice (all of which are wetland dependent products). But all provisioning services depend on water, and fish and rice are no more dependent on it than other products are. These foods and other products as provisioning services will presumably be considered elsewhere for the Aichi Biodiversity Targets indicators framework. Where necessary wetland based products need to be recalled.

The current section focuses on the need to capture the fact that all provisioning services/products – essentially agriculture, livestock and forestry – are underpinned by water-related services and have an impact upon these. Some of these dimensions are already captured elsewhere in this document (for example general agricultural impacts on water are captured under indicators 2.2, 2.6, 6.1, 6.2, 6.3). More dimensions that might be considered, particularly regarding the interface between sustainable agriculture and water, follow.

Secondary indicator 6.1 *Area water-logged by irrigation*	***Relevant targets*** **Main target – 7** **Additional targets –**
Justification An indicator of unsustainable provisioning of food through irrigation. Waterlogging is the state of land in which the water table is located at or near the surface resulting in a decline of crop yields. Irrigation can contribute to the raising of the level of the aquifers. The non-saturated area of soils can become too small and the soils are over-saturated with water. If recharge to groundwater is greater than natural drainage, there is a need for additional drainage to avoid waterlogging. The impacts of this include those on crop production (provisioning service) and biodiversity, particularly soil biodiversity and associated functions.	
Metrics/data availability Part of the land that is waterlogged because of irrigation (expressed as either total area or percentage of total irrigated area). The metric is currently available through FAO AQUASTAT.	
Constraints	

Secondary indicator 6.2 *Area salinized by irrigation*	***Relevant targets*** **Main target – 7** **Additional targets –**
Justification An indicator of unsustainable provisioning of food through irrigation.	
Metrics/data availability Irrigated area affected by salinization, including formerly irrigated land abandoned because of declining productivity caused by salinization (expressed as either total area or percentage of total irrigated area). It does not include naturally saline areas. The metric is currently available through FAO AQUASTAT.	
Constraints In general, each country has its own definition of salinized.	

Secondary indicator 6.3☺ *Crop water productivity*	***Relevant targets*** **Main target – 7** **Additional targets – 4, 14**

Justification

The three variables that define sustainable agricultural crop productivity in terms of efficient resource use are land, chemical (fertilizer/pesticide) and water productivity. Reductions in gross crop production are obviously not acceptable. Therefore, indicators for trends towards sustainable agricultural production would include improvements in the efficiency by which agriculture uses land, chemicals[18] and water[19]. Each can be defined by the amount of production per unit of each resource in use or being consumed. An increase in productivity (resource use efficiency) reflects a reduction in pressure on natural resources (including biodiversity) compared to a business-as-usual scenario.

Water is regarded as a primary constraint to increasing overall agricultural production. The Comprehensive Assessment of Water Management in Agriculture (2007) concluded that crop water productivity was currently, generally, very inefficient and that significant improvements were key to achieving not only demands for increased crop production but also to reducing the footprint of agriculture to within sustainable limits (in addition to better development of rain-fed crops).

Further background information is available in Molden *et al*. (2003).

Metrics/data availability

The key indicator is water consumed by evapotranspiration by agricultural crops/total crop production; likewise for livestock water productivity, based on evapotranspiration data for feedstocks consumed.

Water abstracted by agriculture is not a good indicator since this refers largely to water used for irrigation where often a high proportion is not consumed but returned to the ecosystem (although often with poor quality and other environmental impacts).

One suitable metric is *Water productivity per unit of evapotranspiration* (kg/m^3).

Indicator metrics can be calculated based on data on gross agricultural production and crop water evapotranspiration rates (water use efficiency). Metrics can be disaggregated by type of crop, type of production system (e.g., irrigated *versus* rain-fed) region or country.

There is considerable interest in this topic because of its relevance to food and water security.

The FAO and the International Water Management Institute (IWMI) are the two key organizations currently involved with compiling relevant data and monitoring and reporting on this indicator (these are currently being contacted regarding data coverage, current indicators in use and being developed and relevant reporting schedules etc.)

Constraints

Indicators and datasets are not ideal but are in continuous improvement. Further feedback on constraints is being sought from the FAO and IWMI.

[18] Agricultural crop (and livestock) productivity regarding land and chemical use (sub-aggregated particularly by fertiliser-pesticide use) are also relevant indicators in particular regarding target 7. This document focuses on water productivity.

[19] Total water use by agriculture is included in indicator 2.2 where disaggregated by the use of the water. Indicators for total water use by agriculture, alone, provide limited information. The key issue is efficiency of resource use.

(7) Indicators of enabling conditions (water-related)

Justification:
Enabling conditions include activities which promote, reinforce and facilitate direct actions which are likely to lead to the desired state (Fig. 1), as underpinned by relevant and effective processes. The main Aichi Biodiversity Targets which most closely address such aspects are those under strategic goals A and E. There is generally no shortage of attention to water as such amongst relevant national economic and development planning processes. It is, for example, often the best reflected natural resource in national accounts. The key need is to obtain information on the context in which water is managed and whether this captures relevant ecosystem service and biodiversity considerations.

It is possible, if not essential, to assess this dimension in most indicators that might be used generally to assess progress towards these targets. For example, for target 1: does people's awareness of "the values of biodiversity" include the fact that water is an ecosystem service, underpinned by biodiversity? Such aspects need to be integrated further for each relevant target.

It would be useful to have quantitative methods to assess the relative degree of attention to various biodiversity related subjects. This would enable an assessment of the degree to which policies, management and attention etc., capture the need to achieve a rational and balanced approach, including amongst environment/biodiversity practitioners. Criteria for assessing priority setting, for example, might include economic values of services involved, numbers of people benefiting/affected, trends in services and relevant biomes and underlying biodiversity loss at the species level. Such might be technically difficult, but need to be developed.

The current note focuses on a few key and more specific indicators that are in current use or which can be relatively easily derived.

Storylines:
The extent to which water-related ecosystem services, underpinned by biodiversity, are effectively incorporated (mainstreamed) into planning processes thereby strengthening enabling conditions.

<table>
<tr><td>Secondary indicator 7.1☺

Incorporation of water-related services into national planning processes</td><td>Relevant targets
Main target – 1, 2, 4, 17,
Additional targets – 14, 15</td></tr>
<tr><td colspan="2">Justification
To obtain an overview of the integration of water-related services and biodiversity into relevant planning processes.</td></tr>
<tr><td colspan="2">Metrics/data availability
Information can be derived from existing sources of information. Baseline data, and trends, can be derived from historic records.
The following metrics are relevant and can be calculated:
(1) Degree of incorporation of water-related ecosystem services into national planning processes.
This is the key metric in terms of mainstreaming (for this indicator). Key policy processes include national economic development and sustainable development plans and poverty reduction strategies (or their equivalents).</td></tr>
</table>

Integrated Water Resources Management plans and related water-use efficiency plans are also relevant (see specific indicator on this topic as below).

Sub-metrics also include:

(2) *Existence of a national wetland policy* and degree of its implementation – data available through the Ramsar Information Service and Ramsar National Reports, with regular reporting. The Ramsar Scientific and Technical Review Panel (STRP) has also been able to provide provisional assessments of the effectiveness of wetland policies (see UNEP/CBD/SBSTTA/14/INF/3).

(3) *Degree of incorporation of water-related ecosystem services into National Biodiversity Strategies and Action Plans (NBSAPs) and their implementation.*[20] This includes, *inter alia*: (i) assessment of relative attention to the subject; (ii) degree of incorporation of national wetland policies into NBSAPs (and *vice-versa*).

(4) *Degree of incorporation of NBSAPs (and national wetland policies) into other national planning processes* (those considered under metric 1 above). Interpretation of this would involve consideration in parallel of metrics 2 and 3 above.

These metrics together enable an assessment of the effectiveness of NBSAPs and national wetland policies. The key metric is however number 1 above since this is the desired outcome which can be achieved with or without wetland policies or NBSAPs.

Constraints:
This indicator, and its metrics, is relatively easy to assess in qualitative terms. Work will be required to devise methods to quantify the metrics. Relevant "national planning processes" will vary somewhat amongst countries.

Secondary indicator 7.2 ☺ *Progress in implementation of Integrated Water Resources Management (IWRM)* **(also a target of the JPOI of the WSSD and of significant interest to the CSD)**	***Relevant targets*** **Main target – 19** **Additional targets – 1, 2, 4, 17, 14, 15**

Justification
IWRM is regarded as a key tool to integrate relevant considerations for land, water, biodiversity and environmental management.

The topic was covered by the UNCED Conference in 1992, as stated in Agenda 21 Chapter 18. A global target was agreed at the World Summit on Sustainable Development (WSSD) in 2002 to “Develop integrated water resources management and water efficiency plans by 2005, with support to developing countries through actions at all levels.”

IWRM, if implemented properly, is in effect the application of the ecosystem approach. The UNEP/CBD/SBSTTA/14/INF/3 document notes that a number of Parties report that IWRM is the most advanced form of application of the ecosystem approach in their countries.

Storyline
The extent to which progress is made in implementation of IWRM, as an agreed international

[20] It is assumed that there will be general attention to monitoring NBSAP development and implementation with regards to target 17. The current information requirement could be built into that monitoring.

commitment, and the extent to which the approach incorporates relevant biodiversity/ecosystem services issues, as a means to enable implementation of the Strategic Plan.
Metrics/data availability An assessment of the status of IWRM was included in the second edition of the United Nations World Water Development Report (WWDR 2006). An assessment by the United Nations University (UNU) (2007) was undertaken for progress up to 2005. A further assessment was undertaken by UN-Water (2008) based on a survey of 104 countries (77 of which were developing). Currently, UN-Water has established a multi-agency task force led by UNEP to further assess progress as an important input, through UN-Water and UN-DESA, into the United Nations Conference on Sustainable Development 2012 (Rio + 20); technically "on the application of integrated approaches to the development, management and use of water resources". This is partly in response to the 13th meeting of the CSD, which decided "*to devote, in 2008 and 2012, a separate segment at the end of its review sessions…using one to two days as a benchmark, to monitor and follow-up the implementation of decisions on water and sanitation, and their inter- linkages, taken at CSD-13*".[21] This initiative plans to obtain information from all countries (with 25-30 more selected for detailed assessment). The initiative is funded and operational. In view of the importance placed on IWRM by relevant processes there is a high level of confidence that assessments will be repeated (and improved) in the future. Previous assessments (as above) are semi-quantitative and enable baselines and trends in implementation of IWRM to be tracked. Convention on Biological Diversity National Reports, in particular the third, also contain information on implementation of IWRM but this source of information has been shown to be unreliable (UNEP/CBD/SBSTTA/14/INF/3). Indicator 7.1 is also relevant. The degree of incorporation of IWRM could also be captured under the various metrics for that indicator. Likewise, the degree of incorporation of NBSAPs and national wetland policies into IWRM approaches would be important information (data gathering on this is already included in the current IWRM survey). To strengthen quantitative approaches, a list of 130 Means of IWRM implementation can be audited to assess the performance of management (projects are ongoing at the Centre Régional pour l'Eau Potable et l'Assainissement à faible coût (CREPA), the United Nations Department of Economic and Social Affairs (UNDESA), UNDP, national level and with the World Water Assessment Programme).
Constraints Progress in implementation of IWRM in itself is required information regarding enabling conditions. But in order to tell better storylines information on the extent to which biodiversity/ecosystem services (or "environment" as a proxy) are integrated into IWRM is also necessary. This is difficult to assess quantitatively from previous surveys. Questions on integration of NBSAPs and National Wetlands Policies into IWRM are already incorporated into the current survey being undertaken by UN-Water.

[21] Commission on Sustainable Development, Thirteenth Session, DECISION ADOPTED BY THE COMMISSION, paragraph E:4, http://www.un.org/esa/sustdev/csd/csd13/csd13_decision_unedited.pdf

8. Capturing gender dimensions

Justification:

Paragraph 8 of decision X/2 (the Strategic Plan) "requests Parties to mainstream gender considerations, where appropriate, in the implementation of the Strategic Plan for Biodiversity 2011-2020 and its associated goals, the Aichi Targets, and indicators". This is certainly a significant gap in the current indicators (and targets). This note, therefore, has attempted to explore options.

The inclusion of gender considerations is an important dimension, in particular with regards to water-related ecosystem services. Reasoning to incorporate attention particularly to women includes that women are key stakeholders in terms of motivations to sustain family well-being and water-related ecosystem services is a key component of this. There are very prominent water-related ecosystem service considerations in this including maternal and infant mortality due to water-related impacts, access to safe drinking water and improved sanitation and many other aspects of water quality. Women are also often very prominent in maintaining family food security, an important component of which is water security for food production. The relationships between women (and girls) and water also present some of the clearest and best documented links between gender and ecosystem services (e.g., how improved drinking water supplies liberates women and increases educational opportunities for girls).

Another approach is to explore opportunities for disaggregating data by gender for other relevant indicators – particularly direct measures of human well-being (e.g., access to drinking water). The gender dimension would be particularly informative regarding indicators of enabling conditions (policies and management approaches, etc.) since it is highly likely that women regard ecosystem services differently than men, and in particular have different awareness of and values for them. For example, gender differences in criteria for IWRM would be expected. The above mentioned indicators should capture this where feasible.

The subject is important but relevant indicators are difficult to find. Only one relevant indicator has been included here (as below), although searches continue.

Storylines:
The relevant storylines would build the linkages between biodiversity and water, and trends in services, largely as explained elsewhere in this document, but focussing on the gender dimension.

<table>
<tr><td>Secondary indicator 8.1

Women represented in water management</td><td>Relevant targets
Main target – 19
Additional targets – 14, 15, 4</td></tr>
<tr><td colspan="2">Justification
The logic of this indicator is that representation of women in water management promotes a more balanced and broader consideration of relevant ecosystem services and improved attention to sustainability of these.</td></tr>
<tr><td colspan="2">Metrics/data availability

The indicator Women represented in water management is currently being explored and developed by the World Water Assessment Programme. Data sources are based on national audits.</td></tr>
<tr><td colspan="2">Constraints
The indicator and methods to compile data for metrics are still under development.</td></tr>
</table>

VI. INDICATORS IN USE AND BEING DEVELOPED BY THE UNCCD

46. The ninth session of the Conference of the Parties to the UNCCD, in paragraph 1 of decision 17/COP.9, requested its Committee on Science and Technology to develop proposals, for consideration at the eleventh meeting of the Conference of the Parties, for the refinement of the set of the provisionally-accepted impact indicators being developed to *inter alia* measure progress on strategic objectives 1, 2 and 3 of the 10-year strategic plan and framework to enhance the implementation of the Convention (The Strategy). An interim unofficial "white paper" addressing this topic has been produced (UNCCD 2011).

47. This process is highly relevant to the current note on several grounds. The first, as noted earlier, is that desertification is a process defined and driven by the loss of water from land. Most, if not all of the indicators in use, or under development, by the UNCCD are therefore relevant to the current document in the context of the water and land relationship in dry and sub-humid areas. The second is as an example of a process to address the indicator needs of an MEA.[22] A note was made in section 0 above of the prominent attention to human development related indicators in the UNCCD framework and its development of a conceptual framework for indicator evaluation. In terms of methodological approaches, UNCCD (2011) represents a case study for attempting to quantitatively evaluate indicators using defined criteria based on those developed by the United States National Research Council and the Millennium Ecosystem Assessment. The indicator evaluation criteria were listed in section 0 of this document.

48. Some notes on some of the indicators being considered for the UNCCD and their relationship with the indicators identified above are provided in Table 2.

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[22] Noting that there are differences between the MEAs in modalities and purpose. The indicators for the UNCCD for example include some which are intended to be included as part of national reporting, others are optional in this regard and yet others are useful for assessing tends more generally.

Table 2: Some of the indicators in use or being considered for the UNCCD (UNCCD 2011) and their relationship with water-related indicators identified in this document. An asterisk (*) signifies indicators with particular relevance to other aspects of the indicator framework for the Aichi Biodiversity Targets (not explored further here but worthy of more in-depth consideration elsewhere).

UNCCD Core Indicators **(based on proposed refinements, UNCCD 2011)**	**General indicators**	**Metrics/Proxies**	**Notes regarding relevance to the Convention on Biological Diversity Strategic Plan, the Aichi Biodiversity Targets and indicators suggested in this document**
Strategic Objective 1: To improve the living conditions of affected populations			Closely related to Target 14 (and to some extent the Vision of the Strategic Plan) The inclusion of core indicators S-(1,2,3), the general indicators and proxies (as below for this objective) illustrates the centrality of human development to the UNCCD (currently a weakness in the Aichi Biodiversity Targets and a gap amongst its indicators, see section 0).
Core Indicator S-(1/2/3)* Improvement in the livelihoods of people potentially impacted by the process of desertification/land degradation and drought*	Proportion of population living above the relative poverty line	Rural poverty rate*	This indicator is partly a subset of the Human Development Index (and is an MDG indicator). Recommended by UNCCD (2011) amongst a number of possible metrics due to data availability.
	Water availability per capita	(i) Percentage of population with access to (safe) drinking water	This is MDG Target 7c and the same indicator metric (expressed differently) = indicator 2.2 in this document.
		(ii) Water availability and use	This is a combination of water stress (TWA/TAWR) and water use by sector etc. (indicators 2.1 and 2.2 in this document)
	Food consumption per capita*	Proportion of chronically undernourished children under the age of 5 in rural areas	Not directly relevant to this document, but noting that water availability for food production underpins food supply for children (amongst other factors). The indicator would have utility for other reasons regarding targets 14 and 7.
Strategic Objective 2: To improve the condition of ecosystems			
Core indicator S-4 Reduction in the total area affected	Degree of land degradation*	(i) Level of land degradation*	This is a combined measure of primary soil, vegetation and water degradation. It therefore captures relevant water-related metrics referenced elsewhere.

UNCCD Core Indicators **(based on proposed refinements, UNCCD 2011)**	**General indicators**	**Metrics/Proxies**	**Notes regarding relevance to the Convention on Biological Diversity Strategic Plan, the Aichi Biodiversity Targets and indicators suggested in this document**
by desertification/land degradation and drought		(ii) trends in seasonal precipitation	A measure of rainfall water availability – which is a subset of national/regional total water resources availability data (included in indicator 2.1 in this document which includes additional data on transboundary water inflow into an area). Climate Moisture Index (Aridity Index) may be a better metric (subject to data availability see indicator 2.8) as this combines rainfall and vegetation influences.
	Drought index	Standardized Precipitation Index	See above.
	Capacity of soils to sustain agropastoral use*	GLADIS "Soil Health Status"* (Global Land Degradation Information System; an initiative of LADA)	This is an "integrated" indicator of soil health derived from a number of relevant metrics in the LADA-GLADIS such as soil erosion by water, salinization, compaction, nutrient decline, pollution, water, biomass and biodiversity decline (see earlier discussion on this). The indicator therefore includes metrics on the status of water in and available to soils as a key determinant of soil health (based partly on the FAO AQUASTAT data).
	Change in land use*	(i) Land use* (ii) Land degradation* (iii) Land-cover status*	A set of indicators under the FAO-LADA-WOCAT able to be compiled using a variety of metrics. All three are related to water and land use and land degradation (see above). Land-cover status is highly relevant to water-related ecosystem services as it is a key determinant of water retention properties of soils (and erosion) and local and regional evapotranspiration (re: indicators for soil moisture, 2.7 above, and the Climate moisture Index, 2.8). The land-cover indicator is based on the distribution of 23 of the world's major land-cover categories, as classified by the European Joint Research Centre (JRC) Global Land Cover 2000 product with the baseline set for the year 2000 (JRC 2000). This indicator is worthy of further consideration in the context of this document.
Core Indicator S-5 Maintenance of or increases in ecosystem function, including net	Land-cover status	(i) Land cover*	See above
		(ii) Land productivity*	This is based on an assessment of the potential productivity of land using a number of variables, water availability being a key factor. This is an important indicator regarding the current set of indicators for the

UNCCD Core Indicators **(based on proposed refinements, UNCCD 2011)**	**General indicators**	**Metrics/Proxies**	**Notes regarding relevance to the Convention on Biological Diversity Strategic Plan, the Aichi Biodiversity Targets and indicators suggested in this document**
primary productivity			Aichi Biodiversity Targets as it sheds important light on the "greeness trend" of land (i.e., the relationship between land cover and biodiversity), land status, water availability and net primary productivity (as a proxy for ecosystem services). The International Soil Resources Information Centre (ISRIC), under a subcontract with FAO LADA, has constructed a measure of greenness trend using the Global Inventory Modeling and Mapping Studies (GIMMS) normalized difference vegetation index (NDVI) time series (1981 to 2006) assembled by the University of Maryland. Various calculations are made to express trends in Net Primary Productivity (NPP) to provide a single, tangible indicator: *longterm trend of declining productivity* which may be summed up as loss of NPP in tones of carbon per ha.
	Plant and animal biodiversity	(i) Crop and livestock biodiversity (agrobiodiversity) (ii) Trends in abundance and distribution of selected species (soil biodiversity)	Not directly water-related. Already captured in the 2010 target indicator framework. It is noted that UNCCD refers to these as "CBD indicators" although currently CBD does not refer to any "UNCCD indicators".
Strategic Objective 3: To generate global benefits through effective implementation of UNCCD			
Core indicator S-6 Increases in carbon stocks (soil and plant biomass) Core indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management	Carbon stocks above and below ground*	(i) Aboveground organic carbon stocks* (ii) Below-ground organic carbon stocks*	At the global/national scale, LADA-WOCAT GLADIS and GLADA have developed two indicators to track organic carbon stocks: organic carbon above ground, defined as the status of above ground biomass as a function of land cover in Tons of C /ha, and organic carbon below ground, defined as topsoil and subsoil organic carbon in T/ha. The indicator is a direct measure in relation to target 15. Not directly water-related, although noting that water availability is a key determinant of the ability of ecosystems to store carbon. Water-related indicators as noted in this document are therefore relevant here (in particular 2.1, 2.7, 2.8). This indicator is also a key component of the proposal to illuminate the relationship between the

UNCCD Core Indicators **(based on proposed refinements, UNCCD 2011)**	**General indicators**	**Metrics/Proxies**	**Notes regarding relevance to the Convention on Biological Diversity Strategic Plan, the Aichi Biodiversity Targets and indicators suggested in this document**
			carbon and water cycles (indicator 2.9).
	Land under Sustainable Land Management (SLM)*	Land under sustainable Land Management + plant and animal biodivrsity + change in land use	See above.
	Capacity of soils to sustain agropastoral use*	GLADIS "Soil Health Status"	See above.

VII. NATIONAL-LEVEL CONSIDERATIONS

49. In addition to assessing global trends, the Aichi Biodiversity Targets indicator framework is to be used as guidance for the optional establishment of targets and indicators at national level. The same reasoning for criteria for indicators, as presented above, applies equally to national level considerations. Particular note is made of the need to make the appropriate connections between biodiversity, economics and development, in the context of ecosystem services. This applies not only to water-related ecosystem services (as above) but across the board for all ecosystem services. Guidance for making these connections using the targets and indicators framework, based on the above approach as well as for other relevant considerations) would be a core component of NBSAPs. Capturing relevant indicators in the Aichi Biodiversity Targets monitoring framework is a first step.

50. Regarding the specific indicators identified above, most of the key ones (marked ☺) are already a high priority, and in use, at national level. Metrics for most are in fact based on existing national datasets. There are therefore close connections between the indicators proposed above and primary national level interests.

VIII. OPPORTUNITIES FOR USING DIRECT METRICS FOR BIODIVERSITY

51. As noted above, the strategy in this document is to identify relevant indicators either as direct and already adequate measures of relevant ecosystem services, or as proxies for these. They are used to open up key broader storylines within which the relevant biodiversity sub-storylines can be told. For some, the biodiversity storylines are clear and explicit, for others the indicators require further clarification regarding their relationship to biodiversity.

52. Some direct measures of biodiversity (for example, trends in ecosystem extent and/or condition such as forests or wetlands) can directly underpin necessary storylines. Others, for example, trends in species, will need to be assessed with regards to their relevance to ecosystem services. For some, possibly most of the relevant datasets assessments can be undertaken to investigate what the data can tell us about what is happening to ecosystem services. For example, species trends data can be disaggregated by dependency on relevant biomes/ecosystems and imply trends in their services. There is already a move in this direction. One of the greatest opportunities is to investigate correlations between datasets for direct measures of biodiversity and trends in relevant ecosystem services or drivers of biodiversity loss (for example, trends in water-dependent species and trends in water security).

53. Much attention has already been given to direct measures of biodiversity (e.g., BIP 2010). Connecting these indicators to the storylines opened up in this document, as well as others that can be identified, is obviously an important aspect but this is not considered fully here.

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