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IN-DEPTH REVIEW OF THE PROGRAMME OF WORK ON THE BIOLOGICAL DIVERSITY OF INLAND WATER ECOSYSTEMS

Note by the Executive Secretary

EXECUTIVE SUMMARY

This note summarizes the key messages and findings of the in-depth review based on, *inter alia*: inputs from the Scientific and Technical Review Panel (STRP) and the Secretariat of the Ramsar Convention on Wetlands; the Third World Water Development Report, produced and peer-reviewed by its 43 member organizations and partners of UN-Water (including the Secretariat of the Convention on Biological Diversity); the findings of the Inter-Governmental Panel on Climate Change (IPPC) and various other regional and global assessments of climate change; the inputs of five non-governmental organizations (NGOs) working in the field (including 50 case-studies of their activities); national reports to the Convention on Biological Diversity, the Ramsar Convention on Wetlands and the United Nations Framework Convention on Climate Change (UNFCCC); and the findings of peer-reviewed literature and scientific assessments. Extensive information has been provided and referenced in supporting documents.

The 2010 target and sub-targets for inland waters biodiversity have not been achieved. The rate of decline/loss for some populations where robust data are available has more than quadrupled over the last 10 years. The drivers of biodiversity loss remain unchanged and are all escalating. These include conversion of habitat, fragmentation, the impacts of water use (particularly by agriculture), land use and other impacts on water quality and invasive alien species. Excessive nutrient loading has emerged as an important direct driver of ecosystem change in inland (and coastal) waters and pollution of groundwater remains a major concern. The surface and groundwater portions of the water cycle have been subjected to massive changes by direct human use on local, regional and continental scales. The global limit of ecological sustainability of water available for abstraction has been reached. Regionally, this limit has already been exceeded for about one third of the human population and it will rise to about half by 2030.

Existing conservation efforts in inland waters are certainly insufficient and probably not sustainable (globally); for example, the drivers are degrading the majority of the world's premier wetland protected areas. There is evidence that the multiple direct drivers are increasing the likelihood of nonlinear and potentially abrupt changes in ecosystems. In view of the trends in drivers, slowing the rate of loss of inland waters biodiversity, and consequently achieving sustainable development, is challenging;

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but there are signs that things can and will change for the better. Many tools and approaches to assist implementation are being developed, improved and successfully applied more widely. The loss of ecosystem services from inland waters is prompting major shifts towards ecosystem restoration and rehabilitation, mainly for economic motives. This demonstrates that the main opportunity lies in promoting the advantages of these ecosystems for cost-effective solutions to water and related land-use problems, including disaster risk reduction; the opportunities for redirecting financing towards these ends are considerable. A key way to promote better awareness, implementation and resources for capacity development is to align more clearly "biodiversity" to economic and other social interests.

The elements, goals and activities in the programme of work remain a generally well thought out and reasonably comprehensive foundation for action. The priority needs are for enhanced implementation. Weaknesses with the programme of work include: (i) the limited connection between ecosystem services and climate change; (ii) the lack of emphasis on the relationships between water and biodiversity, ecosystem services and sustainable development; and (iii) its limited impact on other programme areas and in other policy forums.

The IPCC concludes that water and its changing availability and quality will be the main pressures, and issues, on biodiversity, ecosystems and societies under climate change, including for terrestrial, inland water and coastal areas. The water-related services provided by inland water ecosystems are therefore of primary relevance to climate change response options, particularly for ecosystem-based adaptation. There are also significant risks to biodiversity of "mal-adaptation" responses. Climate change mitigation efforts need to pay more attention to the role of both the water cycle and the carbon cycle. These are related and important feedback mechanisms are in play. For example, the capacity of terrestrial ecosystems to store carbon is vulnerable to changes in the water cycle.

Changes in the water cycle have significance for terrestrial, inland water and coastal ecosystems. Water is also our most valuable natural resource: water security for ecosystems and people is widely agreed to be the primary natural resource challenge; water forges strong links between biodiversity and development; and water is the key natural resource link between the various Millennium Development Goals (MDGs) and their targets. Since water is an ecosystem service, it presents significant opportunities for enhanced engagement by the Convention on Biological Diversity across a broad range of economic, development, business, political and public interests.

SUGGESTED KEY RECOMMENDATIONS

The Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) may wish to recommend that the Conference of the Parties adopt a decision along the following lines:

1. *Notes with concern* the overall continuing and accelerating rate of loss of the biodiversity of inland water ecosystems and the rapidly increasing drivers of change in these ecosystems; that the loss of critical services associated with this biodiversity loss, and in particular water-related services, including water supply for both ecosystems and people and the mitigation of hydrological extremes, are already resulting in significant economic and social costs, which are projected to rapidly escalate;

2. *Notes with appreciation* the continuing value of national reports of the Parties to the Ramsar Convention on Wetlands in providing key information on the status and trends of inland waters biodiversity and drivers of change, and *expresses its appreciation* for the inputs of the Secretariat and Scientific and Technical Review Panel of the Ramsar Convention into the in-depth review;

Implementation of the programme of work

3. *Concludes* that the programme of work on the biological diversity of inland water ecosystems remains a good framework for implementation of relevant activities and that the priority needs are for significantly enhanced implementation, and, in particular, improved coherence with land- and water-use policies and activities;

4. *Notes* the need to improve the scope of the programme of work by better recognizing the relevance of inland water ecosystem services to poverty reduction, sustainable development and climate change and the need for better policy coherence between the programme of work and other programmes of work and land- and water-use policies and practices;

5. *Urges* Parties, other Governments and relevant organizations: to strengthen implementation of the programme of work; increase capacity for its implementation, including institutional coordination, with particular emphasis on the contribution of the programme of work to the achievement of sustainable development; and to mobilize significant and additional financial resources for capacity-building for implementation as a means, *inter alia*, to achieve the substantial economic benefits of improved inland water ecosystem management, in accordance with Article 20 of the Convention on Biological Diversity;

6. *Recognizing* the importance of inland water ecosystems on islands, their often unique inland water biodiversity and, in particular, their role in sustaining limited water supplies on islands, *urges* small island developing State, as appropriate, to give increased attention to the implementation of the programme of work;

7. *Urges* Parties and other Governments, where necessary, to re-align their water allocation policies based upon sustainable supply and not demand;

Climate change

8. *Notes* the findings of the Inter-Governmental Panel on Climate Change Technical Report *Climate Change and Water*, which concludes, *inter alia*, that the relationship between climate change and freshwater resources is of primary concern and interest and that expert opinion is that water and its availability and quality will be the main pressures, and issues, on societies and the environment under climate change; *also noting* that the carbon cycle and the water cycle are perhaps the two most important large-scale bio-geological processes for life on Earth and that they are inter-linked with significant feedback mechanisms between the two;

9. *Urges* Parties and other Governments to recognize the prominence of changes occurring in the water cycle when considering the impacts of climate change on people and terrestrial, inland and coastal ecosystems and therefore the importance of the role of the water-related services provided by ecosystems, in particular inland water ecosystems, in ecosystem-based adaptation to climate change; ensure that their climate change mitigation and adaptation activities are designed and implemented in harmony with the needs and opportunities to sustain and/or enhance the services provided by inland water ecosystems; recognize the relationships between the carbon and water cycles in their mitigation activities and, in particular, the need to sustain the water cycle in order to sustain the carbon storage services provided by ecosystems;

10. *Notes* that water provides strong linkages between the interests of the multi-lateral environment agreements and in particular CBD, UNCCD, UNFCCC and the Ramsar Convention, and *invites* Parties and other Governments to build upon these linkages to further strengthen coherence between these agreements at national level; and *requests* the Executive Secretary to use these linkages to strengthen collaboration within the Joint Liaison Group and the Biodiversity Liaison Group;

Scientific, technical and technological matters

11. *Recognizes* the need for enhanced science-policy coordination and integration between the inter-related subjects of biodiversity, terrestrial and inland water ecosystem functioning and service provision, land- and water-use practices, water security, poverty reduction, sustainable development and the achievement of the Millennium Development Goals;

12. *Welcomes with appreciation* the development and expanded use of tools to assist implementation of the programme of work by Parties, other Governments, international and non-governmental organizations and other partners, and *encourages* their further development and wider application whilst *noting* that priority needs lie in the social, economic, institutional and policy arenas in order to better coordinate the management of the multiple drivers of change to inland water ecosystems so as to achieve balanced, fair and equitable sharing of their benefits within the context of sustainable human development;

13. *Invites* Parties and other Governments to recognize the increasing relevance of existing guidance available under the Ramsar Convention and to continue, and strengthen where necessary, consideration of this guidance; and *urges* Parties to both conventions to take more comprehensive measures for joint implementation of the Ramsar Convention on Wetlands and the Convention on Biological Diversity at the national level;

14. *Requests* SBSTTA and the Executive Secretary to include consideration of the implications of changes in the water cycle, and freshwater resources, where relevant and feasible, in all relevant future deliberations in all thematic and cross-cutting programmes of work, and with special attention to the links between hydrology, biodiversity, ecosystem functioning and sustainable development;

15. *Recognizing* the need for improved guidance in the context of the conservation and sustainable use of biodiversity, *calls for* further scientific assessments of the relationship between biodiversity, hydrology, ecosystem services and sustainable development, in particular regarding, *inter alia*, (i) relationships between the carbon and water cycles, and policies and management interventions in each, and the ability of biodiversity to underpin both cycles; (ii) the impact of the direct anthropogenic use of water on terrestrial biodiversity, and *vice versa*, including, *inter alia*, fluxes between soil moisture, groundwater and evapo-transpiration of plants, and shifts in local and regional precipitation, taking into account any additional water-induced stresses on ecosystems through climate change; and *requests* the Executive Secretary and *invites* the STRP of the Ramsar Convention, building upon other assessments and in collaboration with partners, to undertake more comprehensive assessments of these linkages, including by convening expert group meetings, subject to resources, and *invites* Parties and other Governments to provide technical and financial support for this; and *requests* the Executive Secretary to report the findings for the consideration of SBSTTA at a meeting prior to the eleventh meeting of the Conference of the Parties;

16. *Recognizes* the need for improved incorporation of biodiversity and ecosystem service considerations in water-resources scenario planning and *requests* the Executive Secretary and *invites* the STRP of the Ramsar Convention to strengthen and contribute to ongoing processes in this regard, including, *inter alia*, the scenario analysis being undertaken for the Fourth World Water Development Report; and *invites* Parties and other Governments to provide technical and financial support to this end;

Biodiversity and natural disasters

17. *Noting* the already significant economic and social impacts of natural disasters on people, poverty reduction and sustainable development and the role of ecosystems in providing services that reduce vulnerability to and the impact of disasters, in particular water-related impacts such as flooding and drought, and that climate change is anticipated to increase disaster vulnerability and risk, *requests* the Executive Secretary, in collaboration with partners, including the Ramsar Convention and the United Nations International Strategy for Disaster Reduction, and building upon ongoing assessments, to (i) undertake a gap analysis in relation to biodiversity, ecosystem services and disaster risk reduction; (ii) address these gaps through strengthened tools and information, including policy and management guidance; and (iii) develop a capacity-support programme to these ends, as a means to assist Parties to

improve the contribution of the Convention to disaster risk reduction; and *invites* Parties and other Governments to provide technical and financial support to this end;

Biodiversity, water and the hydrological cycle

18. *Concerned* that major anthropogenic changes are ongoing in the Earth's water cycle at the global, regional and local scales through direct water use; that the limits of sustainability of both surface water and groundwater resources have already been reached or surpassed in many regions; that demands for water continue to increase; that these trends will be heightened through climate change; and that water stress on both people and ecosystems is rapidly escalating;

19. *Recognizes* water as a service provided by ecosystems and the role of biodiversity in sustaining the water cycle, including both the availability of water and its quality for both ecosystem and human needs and that water security is essential to, *inter alia*, the achievement of the MDGs collectively, socio-economic well-being, poverty reduction, sustainable cities and sustainable economic growth; *establishes* water as an over-arching subject across the thematic and cross-cutting issues of the Convention; and *urges* Parties and other Governments, and *requests* SBSTTA and the Executive Secretary to make full use of the opportunities that the role of biodiversity in the achievement of water security presents to mainstream biodiversity across a broader political, public and business constituency as a contribution to the achievement of the Strategic Plan of the Convention.[1]

[1] This recommendation in particular has implications for, and may need adjustment in the light of, the revised Strategic Plan of the Convention and might also be brought to the attention of the Working Group on Review of Implementation.

I. INTRODUCTION

1. The implementation of the programme of work on the biological diversity of inland water ecosystems was last reviewed at the eighth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), resulting in recommendation VIII/2, and leading to decision VII/4 in which the Conference of the Parties adopted the revised programme of work. In annex II of decision VIII/10, the Conference of the Parties decided to undertake an in-depth review of this programme of work at its tenth meeting.

2. Guidelines for an in-depth review process were provided by the Conference of the Parties in decision VIII/15, annex III. In addition, in decision VIII/9, the Conference of the Parties, in paragraph 12, decided to consider the findings of the Millennium Ecosystem Assessment (MA) in the implementation and the future review of the programmes of work and cross-cutting issues under the Convention; in paragraph 21, requested SBSTTA to take note in its deliberations of the linkages between biodiversity and relevant socio-economic issues and analysis, including economic drivers of biodiversity change, valuation of biodiversity and its components, and of the ecosystem services provided, as well as biodiversity's role in poverty alleviation and the achievement of the Millennium Development Goals (MDGs); and in paragraph 22, requested SBSTTA to draw upon the lessons learned from the MA process.

3. In paragraph 11 of decision VII/29 on technology transfer, the Conference of the Parties requested SBSTTA to identify methods to increase the contribution of organizations, communities, academia and the private sector to the development and dissemination of scientific knowledge and the diffusion of technology needed for the implementation of the work programmes under review.

4. In decision IX/9, the Conference of the Parties outlined a process for the revision of the Strategic Plan, including paragraph 6(b), which requested the Executive Secretary to, *inter alia*, prepare a synthesis/analysis of issues relevant to the revision and updating of the Strategic Plan, drawing upon the results of the in-depth reviews of the Convention's programmes of work. The current review therefore included attention to relevant needs in relation to the Strategic Plan.

5. In paragraph 5(f) of decision VIII/20, the Conference of the Parties requested the Executive Secretary to develop proposals for further ways and means for: (i) a strategic approach to identify key stakeholders and promote, where appropriate, their full involvement in reducing drivers of negative change and increasing drivers of positive change; and (ii) involving stakeholders in monitoring and reporting on the drivers of change, status and trends of biological diversity and implementation of the programme of work on the biological diversity of inland water ecosystems.

6. This review considered, *inter alia*, the following sources of information: extensive inputs from the Ramsar Convention and its Scientific and Technical Review Panel (STRP), including a detailed assessment of the status and trends of inland water biodiversity and progress towards the 2010 target using indicator data; the findings of the Third World Water Development Report (WWDR3), which includes inputs from all the 26 United Nations member organizations and programmes and the 17 partners of UN-Water; the findings of the Inter-Governmental Panel on Climate Change (IPCC) and various other regional and global assessments on climate change; the inputs of five non-governmental organizations (NGOs) working in the field (including 50 case-studies of their activities); national reports to the Convention on Biological Diversity, the Ramsar Convention and the United Nations Framework Convention on Climate Change (UNFCCC); and the findings of peer-reviewed literature and scientific assessments.

7. The information reviewed and its sources are contained in a detailed background document, made available for reference purposes at http://www.cbd.int/waters/doc/sbstta-14/background-document. A

summary of the findings is made available as an information document (UNEP/CBD/SBSTTA/14/INF/3). Information document UNEP/CBD/SBSTTA/14/INF/1 also provides an assessment, by the Ramsar Convention Secretariat and STRP, of the effectiveness of targets and indicators in the context of the achievement of the 2010 target and sub-targets for inland waters and wetlands as well as related considerations for the CBD Strategic Plan for the period beyond 2010, including a detailed mapping of CBD targets and indicators against Ramsar work in these fields (partly in response to decision VIII/15, para. 25[2]). Some of the key findings of the review, particularly in relation to status and trends in inland waters biodiversity and drivers of biodiversity loss, are also incorporated into the Third Global Biodiversity Outlook (GBO3).

8. Two documents upon which this note is based were posted for peer review from 23 November to 20 December 2009 and subsequently combined into this single note taking into account the comments received. Section II of this note summarizes the status and trends in biodiversity at the species and ecosystem levels and the direct and indirect drivers of change (including climate change). Section III addresses progress in the development and application of tools and approaches to assist implementation. Section IV summarizes findings regarding implementation of the programme of work and its contribution to the achievement of the objectives of the Convention. Section V addresses the outlook, needs and opportunities. The note has focussed on key messages and findings; these are substantiated in the aforementioned documents.

II. STATUS OF AND TRENDS IN BIODIVERSITY AND DRIVERS OF BIODIVERSITY CHANGE

9. ***The 2010 target and sub-targets for inland waters biodiversity have not been achieved. Where more robust and accurate data are available, they suggest that rates of decline/loss are accelerating;*** for example, the observed rate of decline of waterbird populations has more than quadrupled over the last 10 years. There are two areas where some progress towards the 2010 target has been made: (i) some critically endangered populations are being sustained, and some are recovering, due to the implementation of emergency conservation efforts (some waterfowl are a good example); and (ii) total inland water (wetland) protected area has increased significantly (from approximately 1000 sites, covering 74 million ha by the end of 1999, to 1523 sites and 167 million ha as of August 2009).[3] However, progress in protected area coverage is undermined by indications that the condition of many of even the premier sites is degrading over time. There are also gaps in coverage of protected areas by specific wetland type.

A. Status of and trends in species

10. ***The rates of decline in status of freshwater-dependent species continue to be worse than those dependent on other ecosystems.*** The results in the 2008 Living Planet Index (LPI) show an average decrease in the populations of the inland waters/freshwater species studied of 35 per cent over the years 1970-2005; an overall status worse than for terrestrial and marine species (for which the index figures show average declines of 33 per cent and 14 per cent, respectively, over the same assessment period). This observation is generally confirmed by a number of rigorous regional or national assessments (including robust indicator data assessed by the European Environment Agency).

11. Waterbirds are widely regarded as key indicators of wetland ecological status, partly because robust data are available; most are also migratory and their population trends can reflect broader regional

[2] *Invites* the Conference of the Parties to the Ramsar Convention, for areas within its mandate and in line with the role of the Ramsar Convention, established, by decision III/21, as the lead implementation partner on wetlands for the Convention on Biological Diversity, to contribute to the implementation of the targets, to monitoring progress towards them and to developing the targets further for specific application to wetlands.

[3] These data are based on Ramsar Sites of international importance, and there is minor difficulty in analysing the data due to definitional problems of inland versus coastal sites. These data do not include other, not internationally declared, protected areas for which data are difficult to come by.

or ecosystem changes. Throughout the world, considerably more waterbird populations are decreasing than increasing. This pattern holds for all regions and several different groups of waterbirds.

B. Ecosystem-level changes and direct drivers of the loss of biodiversity and ecosystem services

12. ***The nature of drivers of ecosystem degradation and loss remain largely unchanged, although all are intensifying:*** conversion of habitat, fragmentation, the impacts of water use (particularly by agriculture), the impact of the land-based activities on water quality and invasive alien species.

13. Global data for natural wetland area remains a gap but where available they show rates of loss unsurpassed by any other major biome— exceeding 90 per cent accumulated loss in some countries, and 30 per cent from 1990 to 2000 in one country experiencing rapid economic growth (which is probably representative of other countries with expanding economies and infrastructure).

14. Flow has now been altered significantly in more than 60 per cent of the large river systems in the world. Globally, fully one-third of sediment destined for the coastal zones no longer arrives there due to sediment trapping and water diversion, with concomitant increases in the net erosion of sensitive coastal settings like deltas, which require a steady supply of land-derived sediments; these processes are making these areas increasingly vulnerable to coastal storms and sea-level rise.

15. In spite of improvements in some regions, water pollution in general is on the rise globally. Polluted water has a high human health cost. Almost 80 per cent of diseases in developing countries are associated with water, causing about 1.7 million deaths every year. A growing body of evidence indicates that land-based human activities impart a bio-geophysical signal onto river chemistry at the global scale; it has been estimated that only a minority of the world's drainage basins (~20 per cent) still have nearly pristine water quality. Pollution of groundwater remains a major concern because of significant groundwater dependency and the technical and financial challenges of its restoration. Excessive nutrient loading has emerged as an important direct driver of ecosystem change in inland (and coastal) waters. The major source of nutrient input is agriculture. In addition, the majority of wastewater discharged into inland waters remains untreated. Eutrophication is evidenced by increasing harmful algal blooms (and this is a widely reported problem in the fourth national reports under the Convention on Biological Diversity); climate change is also implicated. A further increase in the river input of nitrogen loads of up to 20 per cent globally is anticipated by 2030. Oxygen-depleted (dead) zones are expanding and growing in number globally, in both lakes and coastal zones. Heavy metals from industrial activities, commercial and artisanal mining, and landfill leakages have severe impacts on water and the environment in Eastern Europe, Southeast Europe, the Caucasus and Central Asia. Acidification, caused largely by atmospheric emissions, has been a well documented problem for inland waters for several decades. Natural arsenic pollution of drinking water, a situation compounded by increasingly limited alternative water supply options, threatens as many as 140 million people in 70 countries on all continents. An emerging problem with water quality is the evolving nature of the pollutants involved, with unknown consequences: for example, some residues from the increasing use of pharmaceuticals in more affluent areas are believed to be endocrine disruptors; recent evidence suggests that thawing glaciers (and possibly ice at the poles) are releasing large quantities of accumulated persistent organic pollutants.

16. ***The global limit of ecological sustainability of water available for abstraction has already been reached;*** this is estimated at 4000 km^3 of water withdrawn directly from inland waters, including for irrigation (excluding the 6400 km^3 of rainwater currently used in rainfed agriculture). But due to the uneven distribution of water use and availability, for one third of the world (on a population basis) this limit of sustainability has already been exceeded locally/regionally. On current trends, approaching 50 per cent of the world will be living in areas of high water stress by 2030; 67 per cent will still lack improved access to sanitation. Inland water ecosystems will have to deal with this increasing stress and pollution.

17. ***It is inevitable that, where water becomes scarcer, human activities will take an increasing share of nature's use of water.*** Nature is still the most important player in the water cycle. Evapo-transpiration from forests, natural vegetation and wetlands accounts for an estimated 70,000 km^3/year. In many water-scarce areas there will be pressures to deliberately divert more water from plant transpiration to supplement surface and groundwater availability (for example, by removing forests or halting reforestation).

18. ***The groundwater portion of the water cycle has been subjected to massive changes.*** Problems are emerging on local, regional and continental scales. Particularly in irrigated areas, the consequences of excessive groundwater pumping are disastrous: falling water tables, declining surface water availability including in cases complete habitat desiccation, land subsidence, degradation of groundwater supplies and increased salinization. In many places groundwater use is known to be unsustainable since withdrawals exceed recharge rates or are based on fossil (non-renewable) water resources. There is growing evidence that groundwater depletion is already having major impacts on not only aquatic systems but also on terrestrial ecosystems.

19. ***These trends in water use and their impacts on the water cycle have global significance for terrestrial, inland water and coastal ecosystems.*** Better information is urgently needed on the relationships between the services provided by ecosystems (both terrestrial and inland) and changes in the water cycle.

20. The impacts of "natural" disasters are mostly water related, and have grown much more rapidly than population or economic growth, also suggesting a climate change factor. Such losses often arise largely from the degradation of the disaster mitigation services that functioning inland water ecosystems provide (a point well noted in the fourth National Reports); the value of these services is significant.[4]

21. ***These drivers are degrading the majority of the world's premier wetland protected areas***. Ramsar National Reports show a net deterioration in wetland conservation status, including at Ramsar Sites. Negative impacts of infrastructure developments, tourism, pollution and agriculture are the most frequently intensifying drivers overall, with nearly all drivers intensifying in at least some parts of the countries; none were found to be diminishing overall.

22. Invasive alien species (IAS) remain an important driver of inland waters biodiversity loss and in particular are associated with direct species extinctions. There is evidence that inland water ecosystems are particularly vulnerable to invasions and that climate change will increase this vulnerability.

23. ***There is evidence that the multiple direct drivers are increasing the likelihood of nonlinear and potentially abrupt changes in ecosystems.*** These can be large, difficult, expensive, or impossible to reverse, and have critical consequences for human well-being.

C. Climate change

24. ***The impacts of climate change occur mainly through changes in the water cycle, and this is the key consideration for biodiversity, ecosystems and societies.***[5] The findings of the IPCC third and fourth assessment reports confirm that the changing water cycle is central to most of the climate change–related shifts in ecosystems and human well-being. The IPCC Technical Report *Climate Change and Water* (2008) concludes, *inter alia*, that: "the relationship between climate change and freshwater resources is of primary concern and interest"; so far, "water resource issues have not been adequately addressed in climate change analyses and climate policy formulations"; and, according to many experts, "water and its

[4] A recent study in the U.S.A., for example, values the extreme weather mitigation service (risk reduction) provided by wetlands at US$ 33,000 per hectare for a single storm event (not including the value of other services). Costanza et al. (2008). *The Value of Wetlands for Hurricane Protection*. Ambio 37:241-248.

[5] Acidification caused by carbon dioxide directly is an exception.

availability and quality will be the main pressures, and issues, on societies and the environment under climate change". An expert study for the fifteenth Session of the Commission on Sustainable Development came to similar conclusions, as has UN-Water. Potential and observed impacts on inland water (and coastal) ecosystems are obviously substantial and well documented; these are listed in the background document, and some are also listed in the in-depth review of the programme of work on biodiversity and climate change (document UNEP/CBD/SBSTTA/14/6, and its supporting information documents). But, notably most of the impacts on terrestrial ecosystems, and many on coastal systems, are also driven largely by hydrological factors (e.g., changes in humidity, permafrost/snow/ice cover, soil moisture, rainfall patterns, river discharge, groundwater recharge, sea-level rise, erosion and sedimentation).

25. ***Unsustainable water use and degradation driven by increasing human demand is the main driver of adverse water-related ecosystem changes—climate change is largely an additional driver of hydrological change.*** This exacerbates problems which are patently obvious already. The Third United Nations World Water Development Report (WWDR3) observes the unfathomable paradox that the world is motivated to respond to the impacts of climate change of the future, yet has remained disinterested in taking the actions needed to meet the rising water crisis that is upon us today.

26. Disturbingly, water stress due to both climate and non-climate change trends is forecast to get worse where the population is still growing significantly: Sub-Saharan Africa, South Asia, some countries in South America and the entire Middle East. Climate models show that extremes of rainfall are probably going to escalate, resulting in heavier floods and more frequent and longer droughts in regions already affected by these.

27. ***Solutions to climate change begin by recognizing these realities***. Because water is both a service provided by ecosystems and required for them to function, the primary focus of climate change responses, particularly regarding adaptation, needs to be water security for both ecosystems and people.

28. Inland water ecosystems (wetlands) are the most significant stores of terrestrial carbon, by some estimates storing twice as much carbon as forests; this has already been recognized by the Conference of the Parties in decision IX/16 D, particularly in relation to peatlands.

29. ***Mitigation efforts must pay more attention to the role of both the water and carbon cycles.*** The Economics of Ecosystems and Biodiversity (TEEB) notes that "The carbon cycle and the water cycle are perhaps the two most important large-scale bio-geological processes for life on Earth". The two cycles are linked. Climate change mitigation can have direct and indirect impacts on water resources and hence shifts in biodiversity and ecosystem service provision (including carbon storage). Energy and water use are related. There are also significant feedback mechanisms between vegetation (particularly forests), carbon, groundwater, local precipitation and the partitioning of water flows for human and ecosystem needs. For example: closed canopy forests with high carbon contents drive regional water cycling and cloud formation; three possible example scenarios are (i) deforestation tips the water cycle, dryland forest results (with massive carbon emissions in the process); (ii) the same outcome is driven by the direct use of water, particularly groundwater; and/or (iii) climate change triggers the same process, with or without anthropogenic deforestation or water depletion. These issues are relevant to inland waters because they rely on the same rainfall, groundwater and forest, and illustrate the need to move beyond programmes of work towards water as a cross-cutting subject. They have also raised doubts as to whether some current carbon storage investments, through, for example, forest conservation or reforestation, are sustainable for decades, let alone in the long-term.

30. ***There are significant risks of "mal-adaptation" responses where there is limited awareness of how ecosystems function.*** How society adapts to climate change has significant implications for inland waters biodiversity. Climate change essentially increases water-related risks (too much or too little water). Policies are already increasingly addressing water insecurity by, for example, increasing water storage

(which too often automatically means dam construction); climate change will reinforce these needs. It is critical that as much water as possible is stored back in ecosystems where it can provide multiple and sustained benefits, including sustained water supply and water risk reduction; this means not only in "inland water ecosystems" but also improved use of soil and groundwater storage.

31. A major growing concern for coastal wetlands relates to adaptation to sea-level rise. The picture emerges, in many places, of a "coastal squeeze" with wetlands being sandwiched between increasing coastal defences to a rising sea level and other infrastructure (e.g. cities) behind these blocking the natural migration of wetlands inland[6].

D. Indirect drivers of biodiversity loss

32. ***The sustainability of inland water ecosystems cannot be achieved solely by managing the direct drivers of change in biodiversity.*** Consistent with the findings of the MA and GBO3, major indirect forces are at play in economic, social and political contexts. Competition for water exists at all levels and is forecast to increase with demand in almost all countries. Competition between sectors for water is rapidly escalating. Conflicts between agricultural and urban uses are a paramount concern (81 per cent of humanity is projected to be living in towns and cities by 2030). Water is probably the most critical natural resource upon which cities depend, and sustaining water for, and reducing the water footprint of, cities is already a major global challenge. Yet food production requires more water: globally, more than 70 per cent of water abstracted from inland water ecosystems is used by agriculture for irrigation. Without further improvements in productivity or major shifts in consumption and production patterns, the global demand for water in agriculture alone would increase by 70 to 90 per cent by 2050; yet water use is already unsustainable in many regions.

33. Changing consumer preference for food is possibly as important a determinant of water use as increasing demand for basic staples; for example, basic staples such as cereals require much less water per unit than commodities such as meat. Energy and water are inextricably linked in complex ways. For example: hydropower reservoirs, particularly in dry areas, consume large amounts of water through evaporation; biofuel production requires large amounts of water, yet the water dimension of the biofuel, and of the broader energy debate continues to receive limited attention. Hydroelectric power generation and other renewable energy resources are projected to increase by 60 per cent by 2030. Industry can also consume large quantities of water in addition to the impacts of the wastewater discharged and their pollution potential.

34. ***Achieving water security is now the key natural resource challenge to sustainable development.*** Rapid development is transforming the patterns of water use in emerging economies. Increasing populations and affluence mean escalating water demand and impacts. These, and other, indirect drivers lead to direct influences on resources, and with them impacts upon biodiversity and ecosystem services. While international commentators reflect on the potential for water wars between countries, conflicts over water within countries, including violence and deaths from these, are already intensifying at a worrying rate.

III. TOOLS AND APPROACHES TO ASSIST IMPLEMENTATION

35. There are many tools, guidance and approaches available to support implementation of this programme of work. "Integrated water resources management" (IWRM) remains a key tool to address the multiple objectives associated with the conservation and sustainable use of inland waters biodiversity. Although most Parties did not fully implement IWRM and water efficiency plans by 2005 (a target under

[6] For example, one study in the United States of America estimates that a sea-level rise of just 0.3m could eliminate up to 43 per cent of coastal wetlands; some projections for sea-level rise already exceed this. (National Academy of Sciences, U.S.A., http://www.koshland-science-museum.org/exhibitgcc/impacts04.jsp)

the Johannesburg Plan of Implementation of the WSSD), there are signs that the development and application of IWRM has accelerated over the past five years. The terminology is also now entering major political forums and there are growing efforts in building capacity for using IWRM principles, including a number of major regional initiatives. "Environmental flows" (E-flow) has evolved substantially as a tool and is now targeted more at reversing trends that disconnect ecosystems from livelihoods and sustainable development. There are still few, if any, examples of "ideal" IWRM (or e-flow application) but it is an evolving process based on growing experience amongst a broadening constituency. Nevertheless, Parties have reported that IWRM represents one of the best examples of the use of the ecosystem approach.

36. The incorporation of biodiversity considerations into IWRM remains consistently weak, with too many cases of IWRM application being limited to considering the allocation of water largely for direct use (e.g., food production and urban/industrial uses); another weakness is an over-emphasis on surface waters and neglect of important groundwater (including soil moisture) considerations. Water allocation is also too often driven by demand and needs to be based on sustainable supply. Since external drivers have more impact on water management than many water policies emerging from water managers, the most valuable evolution of IWRM (and related e-flow assessments) would be its extension into dialogue and partnerships with water-using sectors, in particular agricultural, energy and urban uses of water.

37. The tools and guidance made available by the Ramsar Convention are of continuing and increasing relevance. Some other important tools available include: "integrated flood management"; "best environmental practices"; "water footprints"; the "polluter pays principle"; "change in production process" technologies; certification through the International Standards Organization; the World Business Council for Sustainable Development water diagnostic and scenario planning support tool; social marketing campaigns around water issues which can be found in almost all countries; biotechnology has a role in addressing water scarcity and quality challenges by, for example, the development of crops with lower water demands; and nanotechnology shows particular promise for water resources, especially for developing countries with regards to desalinization, water purification, wastewater treatment, and monitoring. The "payments for environmental services" (PES) approach is an increasingly important tool for encouraging and financing environmental protection and conservation of inland waters; its application is advanced in relation to inland waters, partly because of the high value of the services being managed, and is already incorporated in some conventions dealing with water, which serve as a model for development of such approaches under the Convention on Biological Diversity.[7]

38. *Valuing ecosystem services* remains an important tool; although absolute values generated can be controversial, comparative values of services are often very useful. Water-related ecosystem services generate exceedingly high comparative values. This applies not only to inland waters (wetlands) generally but also to terrestrial ecosystems (such as forests).[8] Water is also often the most complete to date in the application of environment accounting. The IUCN *Integrated Wetland Assessment Toolkit* aims to combine work on biodiversity assessment, livelihoods assessments, and economic valuation and brings together the approaches/methodologies for several disciplines into a single source.

39. Feedback from practitioners and from national reports, however, indicates that the major constraints to implementation lie not in the scientific/technical tools available but in addressing social and economic aspects of implementation. In particular, there is an overarching need to improve institutional cooperation and coordination between land- and water-based sectors and jurisdictions and across

[7] For example, the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE Watercourses Convention, 1992) in 2006 adopted guidelines on payments for ecosystem services (PES) in IWRM (see CBD Technical Series 40 for further information).

[8] For example, the Economics of Ecosystems and Biodiversity (TEEB) study has published examples of the values of ecosystem services provided by tropical forests. The water-related services listed include: water provisioning, regulation of water flows, waste treatment/water purification and erosion prevention. These collectively account for a value of up to US$ 7,236 per hectare per year, more than 44 per cent of the total value of forests, and exceeding the combined value of climate regulation (carbon storage), food, raw materials, recreation and tourism.

international borders so as to bring together all interests that may influence outcomes for the sustainability of inland water ecosystems.

IV. IMPLEMENTATION, AND THE CONTRIBUTION, OF THE PROGRAMME OF WORK TO THE ACHIEVEMENT OF THE OBJECTIVES OF THE CONVENTION

A. Progress in implementation reported by Parties

40. Some key indications from the third national reports under the Convention are: (i) there was an under-emphasis on inland water protected area sites; (ii) integration of the programme of work into National Biodiversity Strategies and Action Plans (NBSAPs) was incomplete, but more significantly its role is not reflected adequately in policies, strategies, and plans related to development (including for water resources); (iii) despite the reliance of cities on services provided by inland water ecosystems, and their impacts upon these downstream, only one Party mentioned activities in urban areas; (iv) incorporation of the objectives and relevant activities of the programme of work into enhanced coordination and cooperation between national actors was reported as relatively high but few Parties mentioned coordination at the local level; (v) limited comprehensive measures for joint implementation between the Ramsar Convention and the Convention on Biological Diversity; (vi) data generation for inland waters continued to be dominated by technical and biological interests whereas data on socioeconomic aspects (including goods and services) and threats remained weak; and (vii) implementation of the programme of work was consistently by far the lowest amongst small island developing States (SIDS).

41. The fourth National Reports (based on 70 received by November 2009) indicate a relatively high degree of attention to inland waters, including as reflected through water and land policies and activities, and generally support observations already made regarding status and trends and the main drivers. Widespread attention is being given to: (i) improved target setting and monitoring; (ii) cross-sectoral integration, including IWRM; (iii) enhanced legal frameworks; (iv) impact assessments; (v) ecosystem services aspects and in particular water-related services, such as drinking water and flood mitigation; and (vi) the majority of Parties are emphasizing efforts towards the rehabilitation of inland water ecosystems. Only a limited number of reports from SIDS were available but these express significant interest in water-related issues.

42. Parties report many relevant inland water/climate change activities in reports from both the Convention on Biological Diversity and UNFCCC, including: vulnerability assessments of inland waters and establishing long-term monitoring programmes; restoration of degraded wetlands and halting development in floodplains; water resource management plans for threatened wetlands; improved water management including the establishment of catchment or river basin management plans; reducing threats to people and livelihoods; and the expansion of protected areas networks for inland water ecosystems. Only four Parties reported on activities linking climate change mitigation to inland waters biodiversity, although a number of additional Parties recognized the need to enhance this link. But it is difficult to assess levels of priority accorded by Parties to inland water ecosystems. One exception is the Party that identified 51 activities for its UNFCCC National Programme of Action and prioritized two, both of which centre on addressing improved water management.

B. Implementation by NGOs[9]

43. The activities of five major NGOs (Conservation International, the International Union for Conservation of Nature, The Nature Conservancy, Wetlands International and the World Wide Fund for Nature) working on aspects relevant to the implementation of the programme of work illustrate key successful approaches required, for example: the establishment of partnerships; the use of cutting edge science; linking conservation, livelihoods and poverty reduction; emphasis of the strong relationships among climate change, forest and freshwater ecosystem services; innovative approaches to incentives and financing, including PES, carbon market mechanisms with conservation agreements as the main tool; and water-related certification programmes. Notably, many of their successful contributions to improved outcomes for inland waters centre not on inland waters *per se* but on addressing land and water use policies and activities (as reported also by Parties). All five NGOs very strongly support the view that the best strategy to tackle the various threats to freshwater ecosystems is the application of the ecosystem approach, which in the case of water resources is articulated more often as IWRM or similar terminology. Institutional reform is a strong theme in this.

C. Contribution of the programme of work to the achievement of the objectives of the convention, gaps and challenges to implementation

44. The fact that the loss of biodiversity of inland waters represents probably the fastest acceleration away from the 2010 target suggests that the programme of work on inland waters is the least effective. But implementation must be viewed in the context of the drivers of change, which are considerable, complex, rapidly escalating and probably more severe than for any other programme area.

45. ***The elements, goals and activities in the programme of work remain a generally well thought out and reasonably comprehensive foundation for action.*** Two identified weaknesses with the programme of work are: (i) while containing several references to ecosystem services provided by wetlands, it makes limited connection between ecosystem services and climate change apart from a reference to carbon sequestration and peatlands; and (ii) it does not adequately address nor emphasize water and its relationships with biodiversity and ecosystem services, sustainable development and climate change adaptation (although this gap also applies to all the other programmes of work and is not limited to inland waters).

46. ***The programme of work has limited impact on other programme areas and, in particular, in other policy fora*** (which are largely responsible for the drivers of change). All four Parties that addressed this question (Canada, Comoros, Islamic Republic of Iran and Spain) in their voluntary reports (in response to notification 2008-18) stated unambiguously that the programme of work was generally not influential in the broader policy framework and, importantly, not on water resource policy. There is limited evidence, if any, to refute a conclusion that this is a systemic problem.

47. ***A key way to promote better awareness, implementation and resources for capacity development is to align more clearly "biodiversity" to economic and other social interests.*** There are significant needs in relation to awareness raising and in particular for an elevated profile of the programme of work in relation to sustainable development and land and water use policies and activities; and much better integration of the programme of work into other programme areas is required. Capacity-building needs as identified by Parties and partners remain largely unchanged. The key issue is, however, how to promote the allocation of resources to meet the capacity needs. This requires better alignment between biodiversity and development. This conclusion is particularly pertinent to this programme of work because of the strong links between inland water ecosystem services and sustainable development, with the added linkages with climate change.

[9] The activities, experiences and conclusions of inter-governmental organizations and several other partners are reflected throughout the background document; in particular, in relation to water and ecosystem issues, through UN-Water and the WWDR3.

V. OUTLOOK, NEEDS AND OPPORTUNITIES

48. ***The outlook for inland waters biodiversity and the prospects for the achievement of sustainable development are poor***. Given the indirect and direct pressures on water-related resources, including the impact of land-use practices on water and its quality, and the certain scenarios in trends in these, reversing the rate of loss of biodiversity and ecosystem services of inland water ecosystems is extremely challenging.

49. ***Existing conservation efforts in inland waters are not sufficient and may not be sustainable.*** Inland water protected areas alone are unlikely to ensure sustained conservation of inland waters biodiversity;[10] although there are still needs for strengthening these and other "conservation" efforts. The major opportunities lie in a more proactive approach by engaging in multi-stakeholder dialogue in the context of biodiversity, water resources and sustainable development.

50. ***There are signs that things can and will change for the better***. The first, perversely, is that the history of water shows that better management arises from crisis, and the obviously increasing crises suggest that in many areas better management is inevitable. Second, there is abundant evidence that loss of ecosystem services from inland waters is prompting significant changes in policy. This is driven largely by economic/social motives leading to improved land and water use policies and practices and cost-effective restoration of inland water/wetland related services (and this is evident in many CBD fourth national reports); and experience shows that recovery can be rapid, at least in the case of surface waters, although restoration is not always cheap. Third, existing water management approaches, are well adapted to dealing with uncertainty and risk and have been shown to be receptive to ecosystem based solutions if framed in risk reduction and socio-economic benefit terms. Fourth, implementation of environmental measures is low in most inland water impacting sectors, particularly agriculture; there is therefore scope for substantial improvement. Fifth, the business sector is already demonstrating good leadership in many areas. Finally, public pressure for improved service delivery from inland water ecosystems (in particular improved drinking water and reduced flood risk) is growing.

51. The background document unveils a plethora of good approaches, tools and responses by Parties, inter-governmental and non-governmental organizations, local communities and the business sector. These need to be strengthened and more systematically applied across a much broader range of stakeholders. Tested approaches that show promise include: (i) improving water and land policy and planning; (ii) institutional development; (iii) improved effectiveness and implementation of water law, both formal and customary, including water and environment laws and regulations within other sectors that impact biodiversity and which address a strengthened legal framework for ecosystem service delivery; (iv) consultation and engagement with stakeholders, including business and urban authorities; (v) developing appropriate solutions through innovation and research; (vi) realigning perverse water and related land use and energy subsidies and incentives by reflecting the full suite of ecosystem service considerations in economic accounting for water (including land-use impacts upon it); (vii) strengthening the voice of weaker stakeholders; and (viii) mainstreaming, and institutional and human-capacity development.

52. ***Water is the key natural resource link between the various MDGs and their targets***—not just MDG7 (and its water and environment targets), but arguably most, if not all, of them. Achieving the MDGs sustainably and collectively is not possible without sustaining the water-related ecosystem services underpinned by biodiversity; nor is it possible without understanding and making trade-offs between those various services.

[10] Nonetheless, the review also notes more positively that the water-related services provided by ecosystems (both wetlands and terrestrial systems) are already one of the most important motivations for the establishment and management of protected areas worldwide, especially for forests.

53. The *Comprehensive Assessment of Water Management in Agriculture* (published in 2007 by the International Water Management Institute) concluded that potential exists at the global level to produce enough food and other agricultural products to meet demand while reducing the negative impacts of water use by agriculture. From its scenario analysis, this assessment also noted there are significant local opportunities and options in rainfed, irrigated, livestock and fisheries systems for preserving, even restoring, healthy ecosystems, but those gains require significant changes in the way water is managed and governed.

54. ***The major financing opportunities lie in redirecting other sources of funding; in particular, by investing more wisely in improved natural ecosystem infrastructure to solve water and related land-use problems, thereby reducing long-term financial costs;*** this includes not only inland water ecosystems but related considerations for soil moisture and groundwater. The background documentation presents solid evidence based on case-studies that this can often be done, with improved outcomes for biodiversity conservation as a co-benefit. "Natural infrastructure" solutions to the problems faced in developing countries are particularly promising, especially since financial resources are less available for capital-intensive fixes. Potential financial resources on offer, and economic incentives for this, are astounding.[11] There are additional investment opportunities arising through climate change adaptation. Ecosystem-based solutions to water problems involving cost savings are particularly attractive and more should be sought.[12] These are already being seized in areas such as drinking water supply, flood management, waste recycling (including sanitation) and drought mitigation. These opportunities include restoring the water-related disaster risk reduction and mitigation services provided by ecosystems; disasters have very high economic costs[13] which translate into significant additional justification for financing ecosystem rehabilitation.

55. Natural infrastructure solutions will not necessarily replace physical infrastructure options across the board. Neither are they always cheaper or easier. Rather than having nature and hard engineering compete, the better approach is to frame both approaches under a common ecosystem-based umbrella.

Opportunities for the Convention on Biological Diversity

56. ***There are significant opportunities for enhanced engagement by the Convention across a broad range of economic, development, business and public interests at the heart of the need to mainstream biodiversity.*** Many of the issues and approaches identified here are at the forefront of the convention's interests because the need to address the sustainability of water is so prominent on the

[11] For example, estimates of infrastructure investment required to meet the needs for drinking water and sanitation alone can be as high as US$ 22 trillion by 2030; encouraging only 1 per cent of this to be spent on biodiversity-based (natural infrastructure) solutions results in financing of US$ 220 billion, or about US$ 10 billion per annum (an order of magnitude higher than current total GEF funds including its leveraged financing). The economic cost of water degradation, pollution and over abstraction, in the Middle East and North Africa was estimated in 2008 to be of the order of US$ 9 billion per year, up to 7.4 per cent of GDP. Yet the review demonstrates that rehabilitation of ecosystem infrastructure can solve such problems cost-effectively.

[12] Saving several billion dollars while solving the New York water supply problems by rehabilitating the Catskill watershed, instead of building artificial water treatment facilities, is an often-cited example. Similar approaches in developing countries are achieving similar results (see the background document for these examples).

[13] The existence alone of, mostly water-related, disasters is reported to cause a sustained 14 per cent reduction in GDP of low-income countries; individual disasters can elevate this impact. Related costs are US$ 500 billion per annum in richer nations. Destructive floods observed in the last decade all over the world have led to record high material damage (e.g., in China in 1996 and 1998 - $ 26 and 30 billion respectively). The Mozambique floods of 2000 caused a 23 per cent reduction in GDP and a 44 per cent rise in inflation. Inability to tackle hydrological variability in Ethiopia has been estimated to cause a 38 per cent decline in GDP and a projected 25 per cent increase in poverty for the period 2003–2015. More than 7,000 major disasters have been recorded since 1970, causing at least $2 trillion damage and killing at least 2.5 million people.

political, public and business agendas. Water forges strong links between biodiversity, poverty reduction and development.[14]

57. Water interests are heavily focussed on the need to achieve water security, which includes its sustained availability and quality, and risk reduction; restoration of water-related ecosystem functions has a key role to play in each of these. Water-related services also: generate the highest proportion of the value of services provided by ecosystems and therefore by biodiversity; forge strong links between biodiversity conservation and sustainable cities; are central to climate change adaptation; and, therefore, among the strongest links between the multi-lateral environment agreements, in particular the United Nations Convention to Combat Deforestation (UNCCD), UNFCCC, the Convention on Biological Diversity and the Ramsar Convention on Wetlands.

58. ***The primary need and opportunity is for the Convention on Biological Diversity to address water more comprehensively***. The very many processes and actors already dealing with water demonstrate its importance; this is an opportunity for broader engagement and for improved coherence among the programmes of work, essential to achieve the objectives of the convention. Some options for incorporating the subject into the revised Strategic Plan of the Convention (post-2010) are presented in document UNEP/CBD/SBSTTA/INF/1.

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[14] The review also concludes that addressing water better is a key means towards a more strategic approach to identify key stakeholders and promote, where appropriate, their full involvement in reducing drivers of negative change and increasing drivers of positive change and involving them in monitoring and reporting on the drivers of change, status and trends of biological diversity and implementation of the programme of work as per decision VIII/20, para.5(f).