UNITED NATIONS ENVIRONMENT PROGRAMME
Programme des Nations Unies pour l'environnement   Programa de las Naciones Unidas para el Medio Ambiente
Программа Организации Объединенных Наций по окружающей среде   برنامج الأمم المتحدة للبيئة
联合国环境规划署

UNEP Research Brief:

The need to include ecosystems management as part of the COP 15 Agenda

The purpose is to:

- Define the problem: the imbalance in the global carbon cycle.
- Emphasise the essential role that ecosystems play in moderating the global carbon cycle and therefore climate;
- Highlight the importance of including ecosystem management in the COP 15 agenda and within a global climate change strategy;
- Indicate the cost-benefit advantages of doing this.
- Highlight the socio-economic and environmental advantages of adopting an ecosystems management approach.

Summary:

Whilst human caused greenhouse gas emissions continue to rise, the global capacity to absorb them is declining due to ecosystem degradation. Continuation of this imbalance will lead to climate instability and reduce essential ecosystem services. Appropriate valuation, protection and management of the world's ecosystems achieves two vital joint objectives:

1. Cost effective mitigation and adaptation for climate stabilisation through use of natural carbon sequestration processes.
2. Secured delivery of essential ecosystem services, e.g. clean air, food and water security.

Climate stabilisation can only be achieved by balancing emissions sources (human and natural) and the global ecosystems' sink capacity. The protection and management of the world's ecosystems offers a highly cost effective multiple 'Win' mechanism for mitigation by enhancing sink capacity and protects the essential life supporting ecosystem services that will enable societal adaptation to climate change.

Defining the problem

Even if there were no human activities on planet Earth, carbon would flow through the atmosphere because of natural biological and geological activity. Planet Earth is a dynamic geological and biological system. It produces and absorbs carbon and other greenhouse gases through a range of natural cycles and across a wide variety of ecosystems, which has resulted in the past climate patterns.

Human activity has intervened in these natural carbon cycles in two main ways:

- By creating major new sources of carbon emissions from the use of fossil fuels;
- By degrading natural sinks of carbon by polluting or transforming natural ecosystems.

The combined result of these human interventions has been to change the planetary balance between the sources, sinks and storage pools of carbon. Put crudely, Earth is now emitting more carbon to the atmosphere than it can absorb. This changing imbalance is reflected in a progressive increase in CO_2 concentrations in the atmosphere which has lead to climate change.

Putting these things together, it can be seen that there are three main components to the global carbon cycle.

- Those emissions due to human activity.
- Those emissions from ecosystems.
- There is only one sink: the capacity of global ecosystems to absorb carbon.

This is shown in Figure 1.

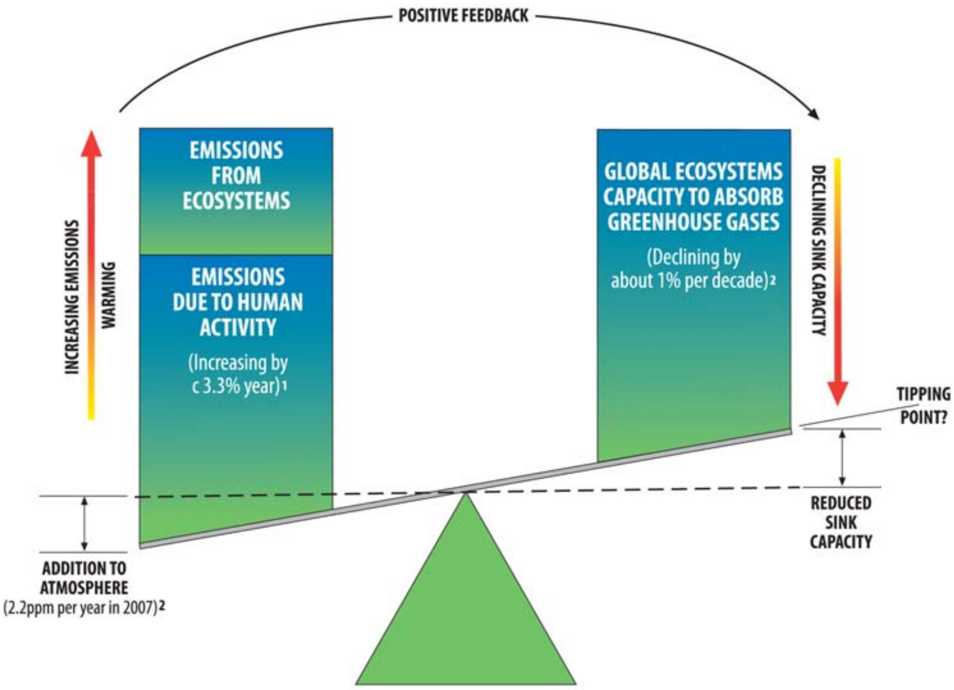

Figure 1. Imbalance of components for climate stabilisation.
[1] Canadell 2007 PNAS, [2] Global Carbon Budget[1]
(Note proportions of size are not to scale and do not reflect actual values of fluxes)

The key observation here is that global and regional ecosystems function as the main climate regulators, both in releasing greenhouse gases (sources) and sequestrating them (sinks) and in other direct and indirect interactions with the climate.

- Ecosystems currently absorb about **half** of anthropogenic CO_2 emissions (Oceans c. 24% and land c. 30%). The remaining amount is the addition to the atmospheric pool.

---

[1] Global Carbon Budget. See: http://www.globalcarbonproject.org/carbonbudget/07/index.htm

- But ecosystem absorption capacity is declining by about 1% per decade and is likely to decline more rapidly due to global warming and human impacts.

At the present time emissions due to human activity are increasing:

- Current estimates put the annual global emissions of CO_2 due to human activities at about 10 Giga tons, of which about 1.5 Gt is from land use change (mainly deforestation).

The net effect is that there is an increasing imbalance between emissions and absorption capacity. ***Therefore to achieve climate stabilisation there is need to manage all three components of the global carbon cycle, not just those resulting from fossil fuels and other human activities.***

The key problem is that one component of the three-way balance is concentrated on as part of the post-2012 negotiations. The current policy is to focus on human based emissions. The risk of this situation is that regulating human based emissions will be insufficient to achieve climate stabilisation.

Climate stabilisation: the need for balance

Examining the global carbon cycle suggests that whilst reducing emissions from human activity must form the basis of our stabilisation strategy it should not be the only part. Indeed there is no guarantee that significant reductions of anthropogenic emissions would on their own result in stabilisation.

As a simplified representation, a three way balance describes the global climate stabilisation problem:

Climate stability = Global ecosystems' capacity to absorb GHGs – (natural emissions from ecosystems + human induced emissions)

The evolution of this will determine to a large extent the speed and magnitude of human induced climate change and the mitigation requirements to stabilise CO_2 (and other GHG) concentrations at any given level[2]. Currently the equation is set so as to lead towards climate instability (see Figure 1). The dangerous paradox is that if emissions due to human activity increase as they are doing, emissions from ecosystems are likely to increase as well (due to positive feedback mechanisms), whilst the capacity of ecosystems to absorb emissions decreases.

Such an imbalance poses substantial risks of irreversible climate destabilisation.

As can be seen from Figure 1, ecosystems function in two of the three components of the stabilisation balance[3]. Again, the danger of not fully recognising and accounting for the role ecosystems play in climate regulation, and looking solely at human based emissions risks addressing only one side of the three way balance.

To achieve stabilisation (or climate resilience), there is need to balance the three components:

- Maximise the global ecosystem capacity to absorb GHGs,
- Minimise emissions from ecosystems (or at least be able to quantify what they are and understand how the processes work) and crucially,
- Reduce emissions due to human activity.

Therefore ecosystems play an unequivocal and increasingly important role in both ecosystem-based mitigation (carbon sequestration and storage) and ecosystem-based adaptation (i.e. foundation to societal adaptation to climate change impacts).

---

[2] Canadell et al 2007 PNAS. See: http://www.pnas.org/content/104/47/18866.full.pdf+html

[3] It can be argued that ecosystems exist in all three components due to their role in underpinning all forms of economic activity, some of which result in human GHG emissions.

Declining absorption capacity

Terrestrial and oceanic ecosystems are currently absorbing about half of anthropogenic CO_2 emissions (Oceans c. 24%, land c. 30%[4]). Without CO_2 sinks, the total CO_2 emissions since 1800 would have caused atmospheric CO_2 to increase from 280 ppm in pre-industrial times to about 500 ppm now[5]. Today's concentration is 387 ppm[6]. But climate change feedbacks and other pressures including land-use change, ocean acidification (due to absorption of CO_2 [7]), pollution and over-exploitation reduce this capacity. The efficiency of sinks in removing CO_2 has decreased by 5% over the last 50 years (about 1% per decade), and will continue to do so in the future. Fifty years ago, for every 1000 kg (1 ton) of CO_2 emitted to the atmosphere, natural sinks removed 600 kg. Currently, the sinks are removing only 550 kg for every 1000 kg of CO_2 emitted, and this amount is falling[8].

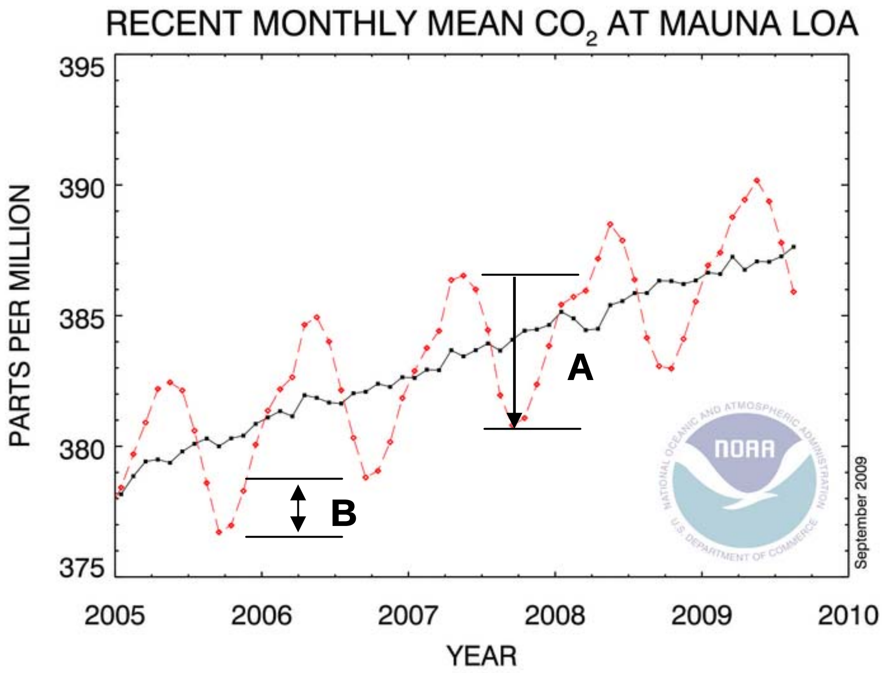

Figure 2. Mean monthly CO_2 concentration cycles showing seasonal patterns (red line) and trend from moving average corrected for the seasonal cycle (black line). Dimension A shows the net decrease in CO_2 concentration in one year (due to absorption particularly during the northern hemisphere summer). Dimension B reflects the imbalance between total emissions (Human and ecosystems) and sink capacity.
Mean monthly data source: NOAA (http://www.esrl.noaa.gov/gmd/ccgg/trends/).

From Figure 2 it can be seen that current ecosystem degradation will decrease dimension A (the net effect of the global sink capacity) and enlarge dimension B (the addition of CO_2 to the atmospheric pool). Conversely, an increase in ecosystem sink capacity (enlarging A) will help negate the imbalance arising in B. Coupled with Human emissions reductions then B can be minimised or even made to be negative.

Ecosystems in feedbacks and tipping points

Strong positive and negative feedbacks exist that interact to give us the climate conditions we currently have. Negative feedback loops are generally good – they help maintain equilibrium. Positive feedback loops are generally very bad and lead to destabilisation. We

---

[4] Cannedell et al 2007. PNAS. See: http://www.pnas.org/content/104/47/18866.full.pdf+html

[5] Raupach et al 2009, The Global Carbon Cycle. In Richardson et al 2009. Synthesis Report. Climate Change: global risks, challenges and decisions Conference, 10-12 march 2009, Copenhagen. See: http://climatecongress.ku.dk/

[6] NOAA. See: http://www.esrl.noaa.gov/gmd/ccgg/trends/

[7] Turley and Scholes 2009, in Richardson et al 2009 (as above) and IPCC AR4 WG I Ch. 5 p403.

[8] Global Carbon Project (2008) Carbon budget and trends 2007
See: http://www.globalcarbonproject.org/carbonbudget/07/index.htm

are in a situation of uncertainty, with declining absorption capacity but increasing human emissions, which is very likely to lead us into a process of positive feedbacks and the probability of exceeding critical thresholds of climate stability.

It is widely debated as to whether we have already reached such a global 'tipping point' with ecosystems responding to positive feedback. If this is the case, or becomes so in the near future, then ecosystem absorption of GHGs will be the ONLY brake effect on catastrophic climate destabilisation.

Most feedbacks that we are learning about tend to be positive (reinforcing), making climate warming worse. These positive feedbacks are generally non-linear, meaning they accelerate to a worsening state. An example comes from the IPCC 4th Assessment Report, which states that a 2 to 2.5°C global average temperature increase above pre-industrial levels may cause many ecosystems to turn from carbon sinks into carbon sources. The current state of the Arctic climate feedbacks is a prime example[9]. These feedbacks must be seen as a serious risk to our actions for mitigation, as they would cancel out our efforts to reduce human emissions. In order to keep global warming below 2°C, global emissions must be reduced to limit the risks of positive feedbacks, whilst at the same time we need to increase the global ecosystem's capacity to regulate the climate.

The IPCC projections for future warming do not currently include carbon-climate feedback responses from ecosystems, as these are difficult to quantify in terms of their amplification effect. This means current temperature projections for the future may be under-estimates. Additional amplification increases above future projections of 4°C (medium-high emissions scenario), range from 0.1°C to 1.5°C as a result of considering the vulnerability of land and sea sinks[10].

Having defined the problem, it is now necessary to establish the solutions.

Solutions that are cost effective and achieve multiple goals.

Protection and management of the diverse range of ecosystems within the world offer substantial cost effective solutions to address all three components of the climate stabilisation balance. These Ecosystem Management[11] solutions are generally non-technology based, rapidly deployable with immediate positive effects and provide a wide range of additional vital benefits to society.

Most important of these are the provision of ecosystems services[12] (e.g. climate regulation, food security, freshwater supply, sustaining health). These are the fundamental units of life support on Earth and underpin all human economic activities. Healthy, fully functional well managed and adequately protected ecosystems achieve ***cost effective objectives for climate change mitigation, adaptation and long-term sustainability, whilst continuing to provide the essential services on which we depend.***

Benefits to society beyond climate regulation:

- Protection and maintenance of ecosystem services.
- Progress towards poverty alleviation.
- Enhanced food and water security.
- Buffering against extreme events.
- Support for disaster risk reduction.

---

[9] Sommerkorn and Hassol 2009. Arctic Climate Feedbacks: Global Implications. See: http://assets.panda.org/downloads/wwf_arctic_feedbacks_report.pdf

[10] Raupach et al 2009. The Global Carbon Cycle. In Richards et al 2009. Synthesis Report. Climate Change: global risks, challenges and decisions Conference, 10-12 March 2009, Copenhagen. See: http://climatecongress.ku.dk/.

[11] **Ecosystem management** can be defined as "an integrated process to conserve and improve ecosystem health that sustains ecosystem services for human well-being". Here the 'Ecosystem management' term is used to encompass ecosystem-based mitigation and adaptation. Ecosystems are defined as encompassing all land and marine based natural and semi-natural systems, and associated land uses including conservation, sustainable livelihoods, pastoralism, agriculture and forestry.

[12] **Ecosystem services** can be defined as 'the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly (de Groot et al 2002, Ecological Economics 41).

However, past inadequate ecosystem valuation through market failures and lack of protection has lead to degradation and therefore a decline in services whilst reducing the ability of ecosystems to regulate our climate. The impacts of climate change coupled with on-going human resource use are likely to cause further ecosystem degradation and are thus further threat multipliers. The opportunities arising from greater investment in ecosystem management to counter this fully conforms with the Shared Vision of the UNFCCC.

International climate negotiations for a post-2012 agreement must incorporate the role of ecosystem management for ecosystem-based mitigation and adaptation. Such an approach must be adequately funded. Current efforts to address climate change focus on reducing human GHG emissions, including deforestation. Beyond this, negotiating text for the UNFCCC currently refers to ecosystems in terms of their vulnerability, need for protection and capacity for providing some ecosystem services. This Research Brief sets out a compelling argument for extending this role and establishing a global wide ecosystem-based management culture as an essential tool in national, regional and international strategies to mitigate against, and adapt to climate change.

Ecosystems: the 'Win-Win-Win' link between mitigation, adaptation and sustainability.

An ecosystems approach can fulfil objectives for both mitigation of, and adaptation to climate change as well as being the foundation for long term sustainability. Protecting ecosystems provides multiple benefits, both directly through sustainable management of biological resources and, indirectly through protection of ecosystem services[13]:

- **Social**; Secure livelihoods, particularly the poor; Health; Cultural and aesthetic values; Community support.
- **Economic** – Resilient ecosystems secure service provision to support all forms of economic activity.
- **Climate regulation** - ecosystems function as tools for mitigation, through appropriate management to reduce natural sources of emissions or increase absorption capacity.
- **Environmental** – Resilient healthy ecosystems have the capacity to support long-term sustainability.

These together provide countless streams of cost effective benefits and opportunities to human societies (economic, cultural, health and many more). Indeed, a fourth 'Win' can be added in that profitable outcomes can be generated by utilising the benefits of healthy ecosystems. It is important to emphasise that the solutions are attainable. Some are relatively straight forward and could be developed immediately and at low cost[14], whilst others will need careful planning, development and larger investments.

Ecosystems as a 'safety net'

The adoption of an ecosystems management approach at a global scale will serve as a 'safety net' against possible failures in the efforts to reduce emissions from human activity. ***However, it must not be seen as an alternative to reducing human emissions, but rather as a complementary mitigation and adaptation approach.***

Whilst it is vital to achieve agreement on emissions reduction, there is no absolute guarantee that the targets set will be either correct or met. It therefore follows, using the precautionary principle, that ecosystems are protected and promoted as the primary mechanism for climate regulation, as well as the foundation for supporting an adapting human society.

---

[13] World Bank 2009: Convenient solutions to an inconvenient truth: ecosystem-based approaches to climate change. See: http://climate-l.org/2009/07/06/world-bank-publishes-report-on-ecosystem-based-approaches-to-climate-change/

[14] Illustrated by marginal abatement cost curves, i.e. Kammen 2007. The benefits of decarbonising the economy. In Richardson et al 2007. See: http://climatecongress.ku.dk/

Understanding the decline in sink capacity– and reversing it.

It is essential to fully understand how much GHG sink capacity is being lost, where, why and what further reductions may occur in the future. Crucially, we need to better understand how to reverse this decline. Appropriate ecosystem management can make a significant contribution to reducing atmospheric GHGs.

'Bio-sequestration'[15] refers to the ability of photosynthesising organisms to capture carbon from the atmosphere. Terrestrial ecosystems have remained relatively constant in the sequestration efficiency, and have the potential to grow as sinks (if given adequate protection and management), whilst the capacity of the oceans may have been reached and is now declining (primarily due to acidification).

Current estimates put the annual global anthropogenic emissions of CO_2 at about 10Gt, of which about 1.5 Gt is from land use change (mostly deforestation, at about 13 million hectares per year, accounting for some 20% of global CO_2 emissions[16]). This is a prime example of upsetting the balance, as deforestation releases CO_2 whilst also decreasing sink capacity. Deforestation will release an estimated 87 to 130 billion tonnes of carbon by 2100, which is greater than the amount of carbon that would be released by 13 years of global fossil fuel combustion[17]. Reducing emissions from deforestation will be essential for our objective of limiting global warming to 2°C. (UN-REDD[18]) It is cost-effective with clear additional benefits of protecting the livelihoods of the poor and conserving biodiversity. The Eliasch Report[19] states "The cost of halving global carbon emissions from 1990 levels could be reduced by up to 50% in 2030 and by up to 40% in 2050 if the forest sector is included in a [carbon] trading system. This is due to the relatively low cost of forest abatement compared to some mitigation in other sectors. These lower costs could also allow the international community to meet a more ambitious global emissions target".

What is the Ecosystems Approach?

'An Ecosystems Approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way' [20]. It is a holistic way of dealing with natural resource management, where integration between issues is the key element. As such takes a holistic, inter-disciplinary integrated approach that recognises the inter-connectivity between ecological, social-cultural, economic and institutional structures.

It is management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function[21]. The IUCN[22] defines it as "a process that integrates ecological, socio-economic, and institutional factors into comprehensive analysis and action in order to sustain and enhance the quality of the ecosystem to meet current and future needs".

The central goal of ecosystem management is sustainability, where the emphasis is on delivering ecosystems services for current use without compromising the ability to provide them in the future. A fundamental aspect is the need to protect sources of resources[23]; that is, ecosystems require appropriate protection to ensure the provision of ecosystem services[24]. It is biodiversity that is the key to supporting resilient, productive, and healthy functioning ecosystems and therefore underpins the provision of ecosystems services.

---

[15] Trumper et al 2009. The Natural Fix? The role of ecosystems in climate mitigation. A UNEP rapid response assessment. United Nations Environment Programme, UNEP-WCMC.

[16] Parry et al 2007. IPCC AR4 WGII. See: http://www.ipcc.ch/

[17] See: http://www.csiro.au/news/GlobalCarbonProject-Deforestation.html

[18] See UN-REDD http://www.undp.org/mdtf/un-redd/overview.shtml

[19] The Eliasch Report: See: http://www.occ.gov.uk/activities/eliasch.htm

[20] United Nations Convention on Biological Diversity (2000). See: http://www.cbd.int/

[21] Christensen et al (1996) Ecological Applications 6 (3) 665-691. The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management. Ecological Applications: Vol. 6, No. 3, pp. 665-691. See: http://www.esajournals.org/toc/ecap/6/3

[22] IUCN. See http://www.iucn.org/about/union/commissions/cem/cem_about/

[23] Grumbine (1997) Conservation Biology 11 (1) 41-47.

[24] See http://www.iucn.org/about/work/initiatives/climate_news/_/climate_change_and_ecosystem_management/

People in the balance.

There is need to balance many opposing demands. Human population is expanding and the expectation of an increasing number of people is for living standard improvement and material gain, placing additional demands on resource use. To achieve a balance there needs to be a shift in human expectations, aspirations and behaviour and immediate resource use. ***At the same time it must be recognised that poverty alleviation is a primary objective.*** The aspirations of the poor need to be respected and support given to realise them, whilst on the other hand excessive resource consumption needs to be reduced in order achieve suitable levels of equity. Ecosystems provide the essential basics for livelihood provision, particularly for the poor, whilst excessive resource demands from the wealthy cause ecosystem degradation.

The key to many of the solutions in terms of practical application, is using through behavioural change. Fundamentally, people adopt new ways of doing things if,

a. There is an economic benefit,

b. There is a clear rationale as to why change is needed.

Thus in making effective change there is need for new economic systems and investment in education.

Priority areas of action

Ecosystem degradation and biodiversity loss are the most serious threats to the local, national and international scales of ecosystem services provision, including climate regulation. To address this:

Firstly, strengthening Ecosystems governance and institutions at local and national levels is a pre-condition for any effective policy response.

Secondly, it should be explicitly recognised that one of the main drivers for ecosystem degradation is economic, and that the past lack of ecosystem valuation has been a market failure, e.g. forests are destroyed because it is more profitable in the short term to use land for other purposes. Therefore an effective policy has to reward the value of the services provided by ecosystems above that of the short term gain. There is need therefore for an economic mechanism that fully values ecosystems and the services they provide.

Thirdly, because ecosystems degradation is a global issue requiring solutions at the local to global scale (the aims being to stabilise CO_2 emissions at an acceptable level and to halt biodiversity loss), the international climate negotiations provide a unique opportunity to come to grips with ecosystems loss. The UNFCCC CoP15 should feed ecosystem management considerations into the negotiations.

Fourthly, if change is to be designed and implemented properly, it must be based on high quality information. Existing ecosystem monitoring and assessment programmes are either incomplete or only partially integrated. The money spent on ecosystems research and monitoring does not reflect the true value of the services that ecosystems provide to the global economy. More support for science to provide the basis for a comprehensive science-based management approach is required to guide policy decisions and monitor implementation.

Four complementary strategies are required:

1. Political commitment. There must be a sense of urgency to raise the profile of ecosystems in climate change policy setting at local, national and international levels.

2. Investment. There must be explicit inclusion of investments related to ecosystem management and ecosystem protection, especially as part of a Global Climate Change Fund. The scale of investment must be commensurate with the value of the ecosystems services.

3. Incentives. There must be a deliberate focus on introducing incentives to reduce emissions, ease existing pressures on ecosystems and support changes that increase environmental resilience and resource sustainability, including incentives for increased land and water protection.

4. Information. There must be a solid commitment to establish comprehensive information and foster closer links between ecosystem management, climate-change adaptation and disaster risk reduction communities, as well as between science, economics, politics and policy. In addition, there must be increased information sharing between countries, including North-South and South-South exchanges. Monitoring of crucial environmental variables and processes related to ecosystem-based climate change mitigation and adaptation must be expanded and supported over the long term.

The following are seen as some of the fundamental solutions in support of the above four complementary strategies:

- Addressing market failures through appropriate valuation of ecosystems and the services they provide[25]. A fundamental shift is required away from valuing *private* goods and services towards valuing public benefits of ecosystems where ethics play a central role (*All strategies*).
- Continue development of funding mechanisms to support inclusion of ecosystem-based solutions for mitigation and adaptation, capacity building and innovation[26]. (*Strategy 2 – Investment*).
- Greater integration between knowledge of economics, ecosystems and their management at governmental level, recognizing the limitations on human activity posed by ecosystem capacity. (*Strategy 1 – Political commitment*).
    - Greater balance between traditional economics and ecological economics within the knowledge capital of governments and financial institutions.
- Foster approaches of 'local solutions for global problems', and 'meeting local needs within global level objectives'. This requires a global over-arching ethos of conservation, sustainable resource use based economies and knowledge of ecosystem functions and processes influencing GHG fluxes. (*Strategy 3 - Incentives*)
- Promote public education and facilitate behavioural change. People need to know the consequences of their actions in order to know how to make informed decisions affecting their lifestyles and consumer choices. Society also needs to be better aware of why governments aim to change individuals' behaviour, through better up-dates on the state of the climate and ecosystem health. (*Strategy 4 – Information*).
- Assured funding for environmental protection. To ensure appropriate protection of ecosystems and services, a secured funding mechanism is needed to insure against variation in the global economy. It must provide long-term support for ecosystem protection and restoration efforts. (*Strategy 2 – Investment*).

The following are recommended:

- Ensure ecosystem-based adaptation is an integral component of climate change post-2012 discussions, at international, national and regional scales.
- That Governments recognize, acknowledge and fully value the role of healthy ecosystems in climate change mitigation and adaptation.
- Emissions from ecosystems and the GHG stocks they store need to be included in the sectors reported by the UNFCCC (adding to the human induced sectors).
- Existing stocks of carbon in ecosystems (e.g. soils, vegetation) must be protected and prevented where possible from causing further emissions.
- Enhance ecosystem sink potential and avoid source risk (i.e. reduce deforestation).
- Recognise the global 'public good' of ecosystem interactions and ecosystem services which transcend national boundaries.
- Align climate change policies with other relevant conventions, including habitat, water and biodiversity conventions (e.g. Convention on Biological Diversity).
- Incorporate ecosystem-based mitigation within Nationally Appropriate Mitigation Actions (NAMAs) and ecosystem-based adaptation into National Adaptation Plans of Action (NAPAs).
- Encourage funding for national and local level projects that strengthen ecosystem resilience and help build adaptation capacity in human systems.
- Develop education, training and communication capabilities.
- Emphasize strategies that promote:
    - Legally-designated and effectively managed protected areas.

[25] TEEB – The Economics of Ecosystems and Biodiversity.

[26] World Bank. http://siteresources.worldbank.org/ENVIRONMENT/Resources/ESW_EcosystemBasedApp.pdf

 - Integrated sustainable resource use from ecosystems.
- Support research and action on:
  - Climate-ecosystems interactions and feedbacks.
  - Ecosystem processes and functions.
  - Development of climate modelling that include ecosystem feedbacks.

Practical steps in Terrestrial systems:

- Develop and enforce appropriate ecosystem protection measures.
- Human society to understand and live within the constraints of ecosystems and services.
- Reduce rates of deforestation and other land use change and support active restoration.
- Link ecosystem management with an Integrated Water Resource Management approach. As a priority, protect fresh water resources and ecosystems processes that provide them.
- Support farmers and other land managers in developing diversified and resilient eco-agriculture systems that provide food, water and other critical ecosystem services[27]. Improve food energy efficiency to reduce pressures on ecosystems.
- Comprehensive monitoring of ecosystem health and functional processes.

Examples of forest based actions include: implementing soil conservation measures; extending rotation cycles in production forests; accommodating forest development to changing conditions; adaptive fire management including maintaining natural fire regimes where possible; enhancing resilience of managed forests by increasing the diversity of species, age, and spatial distribution; protecting primary forests; and identifying and protecting 'functional' groups of ecologically important species.

In agriculture and pastoral systems: maintaining soil carbon stocks, conserving agricultural genetic resources, reducing other threats to farmland biodiversity, restoring degraded land, integrating land and water management, establishing disease control programmes for native livestock, and invasive species management. Other adaptations include, changes to cattle feed regimen to reduce methane emissions, zero tillage, use of straw for carbon capture, organic production systems, anaerobic digesters for energy generation from livestock waste.

Practical steps in Marine systems:

- Invest in developing a better understanding of oceanic processes:
  - Circulation (including prediction of oscillations), biogeochemical processes, ocean-atmospheric exchanges.
  - Species responses to altered temperature and pH.
- Use natural systems for sea level rise and storm surge defence.
- Regulate the transfer of materials from land to sea, such as pollution and eroded soil.

Examples include: improving management of sewage discharge; restoring degraded coastal ecosystems such as mangroves and coral reefs; establishing marine protected areas; enhancing monitoring programmes; developing pollution contingency plans; diversifying livelihoods in coastal communities; and full economic valuation of marine and coastal resources.

Preserving an abundance of organisms (plants, animals, micro-organisms, fungi) and multiple groups performing similar functions maintains resilience. A diversified portfolio of "insurance" species provides back-up if some species decline. Crucially, higher genetic and species diversity tends to make ecosystems more resistant and resilient to disturbance. This is because species are likely to be present with characteristics that can survive and perform under a range of environmental conditions, allowing the ecosystem to adjust to change and to maintain the provision of critical services.

---

[27] Nelleman et al 2009. The environmental food crisis – the environments role in averting future food crises. UNEP. See: http://www.grida.no/publications/rr/food-crisis/

Ecosystems as the basis for a new 'Green Economy'[28]

The sustainable utilisation of resources from ecosystems can form the foundation for building a new 'green economy' – where:

- Natural resource use matches ecosystem supply capacity.
- Is based on renewable energy.
- Has a low carbon footprint.

The foundation for this is the protection and maintenance of biodiversity, ecosystems and the provision of ecosystem services. Coupled with moves towards renewable energy production and carbon trading schemes, ecosystems provide new markets to support economies through a focus on multiple ecosystem services. Adjustments to national and international economies may be difficult and slow. Utilising the climate regulation capacities of ecosystems provides governments with potentially more time for their populations to adjust to a new green economy. Likewise, by combining ecosystem management approaches that maintain ecosystem health with a sustainable utilisation of resources, there is an increased probability of achieving such targets as the Millennium Development Goals.

Conclusions

Developing policies and economic strategies that place ecosystems and the services they provide at the centre of future economic development and climate change mitigation and adaptation efforts will result in multiple positive benefits to all people of the World. An ecosystems approach is an essential, cost effective part of the 'tool kit' to tackle climate change and in progress towards long-term sustainability. The multiple benefits include cost effective:

- Enhanced climate regulation through re-balancing of the carbon cycle.
- Protection of essential ecosystem services including enhanced food and water security, public health and societal wellbeing.
- Reduction of risks of further ecosystem degradation and subsequent societal disruption.

Fundamentally, the Ecosystems Approach ensures that the essential systems for life support on Earth are correctly valued, protected and managed.

Imperative

The imperative for the Copenhagen 15th Conference of the Parties still remains to agree a Convention to regulate GHG emissions from human activity. The arguments presented here supporting the inclusion of ecosystem management reinforces the need for a successful agreement. The inclusion of an ecosystems management approach as part of the Convention should be seen as complementary to setting emissions regulations. As climate change brings to bear additional stresses, we need to ensure that ecosystems no longer degrade. We must ensure that they remain healthy and fully functional in order to provide the vital ecosystem services we rely on.

The greatest challenge for governments and global leaders is to adjust national and international economies in line with mitigation and adaptation efforts whilst maintaining financial stability. Use of the climate regulating capacity and other life support services of ecosystems will help economies, financial institutions and societies to make those adjustments in progress towards a sustainable economy. Fundamentally, ecosystems form the foundation of life support and hence require appropriate protection and management.

It is vital therefore that the issue of ecosystem management be included in the COP15 agenda and a post-2012 agreement.

---

[28] Greening the economy refers to the process of reconfiguring businesses and infrastructure to deliver better returns on natural, human and economic capital investments, while at the same time reducing greenhouse gas emissions, extracting and using less natural resources, creating less waste and reducing social disparities.

This research brief was drafted by:

Dr. Richard Munang[29]
Climate change adaptation Unit
Division of Environmental Policy Implementation (DEPI)
United Nations Environment Programme (UNEP)
Email: Richard.Munang@unep.org

Dr. Jian Liu
Chief, Climate Change Adaptation Unit,
Division of Environmental Policy Implementation (DEPI)
United Nations Environment Programme (UNEP)
Email: Jian.liu@unep.org

Mike Rivington,
Macaulay Land Use Research Institute,
Craigiebuckler, Aberdeen.
AB15 8QH, Scotland.
E-mail: m.rivington@macaulay.ac.uk

Ibrahim Thiaw
Director,
Division of Environmental Policy Implementation (DEPI)
United Nations Environment Programme (UNEP)
Email: Ibrahim.Thiaw@unep.org

Acknowledgements:

We are grateful to **Prof. Mary E. Power** of the Department of Integrative Biology, University of California, Berkeley, **Dr. Jamison Ervin**, of the Supporting Country Action for CBD Programme of Work on Protected Areas UNDP/GEF/UNOPS Global Project, **Dr. Cassandra Brooke** Manager Climate Change Adaptation Science, WWF, **John Scanlon**, Principal Advisor to the Executive Director, UNEP, **Prof. Richard Aspinall** and **Dr Richard Birnie**, Macaulay Land Use Research Institute and **Prof. Pete Smith**, Aberdeen University, for additions and comments on different versions of this paper.

Referencing this Research brief

UNEP (2009) *Research Brief: The need to include ecosystems management as part of the COP 15 Agenda*. [Core writing team, Richard Munang, Mike Rivington, Jian Liu & Ibrahim Thiaw (eds)] Climate Change Adaptation Unit, DEPI/UNEP, Nairobi, Kenya.

Important information about this paper – Notes from the authors:

This brief is part of a more detail publication. It is beyond the scope here to cover climate change issues in any detail. Instead readers are referred to the IPCC Fourth Assessment Report (http://www.ipcc.ch/) for a comprehensive coverage, and the Synthesis Report of the Climate Change: Global Risks, Challenges and Decisions Conference, 10-12 March 2009, Copenhagen (http://climatecongress.ku.dk/), for an up-date of the current situation. The subjects of ecology, ecosystem management and ecological economics are also large, but we have assumed a lesser understanding of these subjects on the part of the reader. We have aimed at capturing the essential aspects of these subjects at a very generic level.

Where possible we have used reports and journal articles that are available on-line to allow readers easier access to supporting material, but this selection is by no means comprehensive or fully representative of the vast range of material available

[29] Corresponding author