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

UNEP Research Brief:

Ecosystem Management: part of the Climate Change Solution

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 achieve two vital 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 CO2 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.

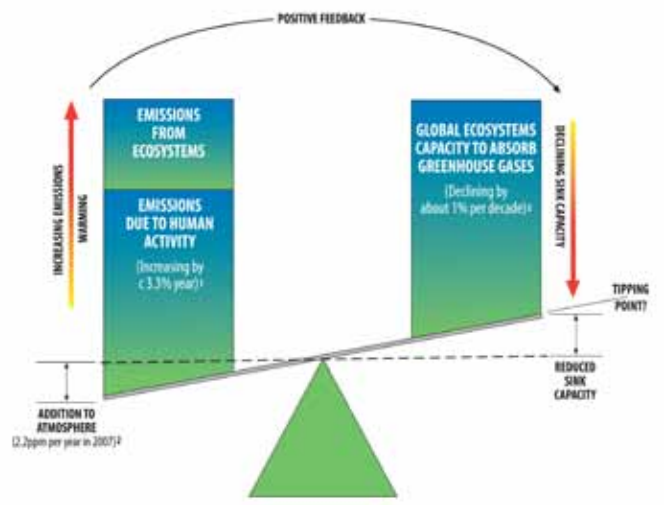

Figure 1. Imbalance of components for climate stabilisation.
[1]Canadell 2007 PNAS, 2 Global Carbon Budget
(Note proportions of size are not to scale and do not reflect actual values of fluxes)

1 (2009) Blue Carbon: http://dev.grida.no/RRAbluecarbon/pdfs/update/Blue-Carbon_print12.10.09.pdf

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 CO2 emissions (Oceans c. 24% and land c. 30%). The remaining amount is the addition to the atmospheric pool.

- A recent UNEP new rapid response assessment titled Blue carbon: the role of healthy oceans in binding carbon unequivocally indicated that of all the biological carbon, or green carbon captured in the world, over half (55%) is captured by marine-living organisms – particularly, mangroves, salt marshes and seagrasses - hence the new term blue carbon. Blue carbon sinks and estuaries capture and store between 870 to 1,650 million tons of CO2 every year - or the equivalent of up to near half of the emissions from the entire global transport sector which is estimated annually at around 3,700 million tons of CO2, and rising. **Combined with action under Reducing Emissions from Deforestation and Forest Degradation (REDD), halting the degradation and restoring lost marine ecosystems might deliver up to 25% of emission reductions needed to keep global warming below two degrees Celsius.**
- But ecosystem absorptive 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 CO2 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 CO2 (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).

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[4] :

- **Social;** Secure livelihoods, particularly the poor; Health; Cultural and aesthetic values; Community support.

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.

4 **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/

- **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[5] , 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.

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'[6] 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 CO2 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 CO2 emissions[7]). This is a prime example of upsetting the balance, as deforestation releases CO2 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[8] . Reducing emissions from deforestation will be essential for our objective of limiting global warming to 2°C. (UN-REDD[9]) It is cost-effective with clear additional benefits of protecting the livelihoods of the poor and conserving biodiversity. The Eliasch Report[10] 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'[11] .

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[12] .

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[13] ; that is, ecosystems require appropriate protection to ensure the provision of ecosystem services[14]. It is biodiversity that is the key to supporting resilient, productive, and healthy functioning ecosystems and therefore underpins the provision of ecosystems services.

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5 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/

6 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.

7 Parry et al 2007. IPCC AR4 WGII. See: http://www.ipcc.ch/

8 See: http://www.csiro.au/news/GlobalCarbonProject-Deforestation.html

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

10 The Eliasch Report: See: http://www.occ.gov.uk/activities/eliasch.htm

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

12 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

13 Grumbine (1997) Conservation Biology 11 (1) 41-47.

14 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.

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.
1. **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.
1. **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.
1. **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 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.
  - ◊ 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.

Ecosystems as the basis for a new 'Green Economy'[15]

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

15 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.

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.

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

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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, **Tim Kasten**, Deputy Director, DEPI, **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

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