Strengthening the scientific evidence base of a new climate agreement

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Abstract. Ahead of the forthcoming global intergovernmental climate meeting in Paris, scientists met in Paris in July at a large scientific conference calling for an ambitious agreement aimed at holding global warming to 2°C. With agriculture, forestry, and other land use contributing 24% of total greenhouse gas (GHG) emissions (2000–2009), there is potential for significant ecosystem-based mitigation benefits. Similarly, maintaining healthy ecosystems represents, in many situations, the most efficient way of adaptation. This paper highlights some scientific aspects, as presented at the conference, related to ecosystem-based adaptation and mitigation. It calls for enhanced cooperation between scientists, policy makers, and other stakeholders.

Key words: adaptation; agriculture; climate change; ecosystems; international agreements; mitigation; science–policy links; stakeholder cooperation; sustainable development.

Introduction

Next month, governments will meet in Paris under the aegis of the United Nations to seal a new international climate agreement. The meeting represents the 21st session of the Conference of the Parties (COP) to the UN Framework Convention on Climate Change (UNFCCC). COP21 is to produce a cooperation framework among governments and other stakeholders for a steady increase of individual and collective ambitions for addressing the challenge of climate change. The new climate governance regime is intended to set the rules and strengthen confidence among the nations of the world concerning nationally determined climate action commitments, support implementation of mitigation and adaption measures in developing countries, maximize benefits of international cooperation, and consolidate awareness worldwide that humanity must transition urgently to a new, low to zero carbon-based development model and to resilient societies.

Science Supports Ambitious Outcomes at COP21 and Beyond

Science must be at the heart of this new climate agreement and its implementation. To this end, science must be progressively broadening from assessing risks and options for action to also understanding and helping enable transition pathways to sustainable and resilient economies and societies. In order to strengthen the evidence base of the new climate agreement and to further explore this essential and expanding role of science, the global scientific community gathered in Paris in July 2015 at the International Scientific Conference “Our Common Future under Climate Change” (CFCC). This four-day event was the largest international forum for scientists to come together ahead of COP21. Building on the results of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-AR5; IPCC 2015), the conference addressed climate change in the broader context of global change and sustainable development. It presented the state-of-knowledge, storylines, and scenarios of our common future under climate change and explored contours of a resilient and sustainable global future. More particularly, it discussed solutions for both mitigation and adaptation challenges relevant to COP21. The final day was focused on collective action among stakeholders and across sectors, and on exploring transformative solutions. The conference provided an opportunity for many researchers, as well as research organizations and programs, to refine their research agenda for the years to come.

The event, an initiative of leading French scientists, was organized under the umbrella of the International Council for Science (ICSU), Future Earth, the United
Ecosystems and Climate Change: Problem and Solution Spaces

Here I set out, in summary form, the evidence base, as presented at the CFCC conference, related to ecosystems under climate change, with a view to including in the new international climate agreement an important component of ecosystem-based approaches to adaptation and mitigation, in particular in the forestry and agriculture sectors.

The role and importance of terrestrial and marine ecosystems as sinks and reservoirs of GHG is recognized in the 1992 UNFCCC Convention text (United Nations 1992). The Convention also includes explicit references to forestry and agriculture as sectors in which anthropogenic GHG emissions should be reduced or prevented. However, while forests and land use change have been made an integral part of the international mitigation agenda from the beginning (1995) and were also recognized in the Kyoto Protocol (adopted in 1997), agriculture has received less attention by the UNFCCC (available online).  

At the CFCC conference, forests and other terrestrial, as well as marine, ecosystems, land use change, and agriculture/food security received full attention throughout the four days, including side events. In fact, an important part of the conference program was focused on the impacts of climate change on the natural environment and on the science for ecosystem-based approaches to mitigation and adaptation.

Knowledge of observed and projected severe impacts of climate change on ecosystems and biodiversity has been expanding rapidly. For example, we now know that multiple components of climate change are projected to affect all pillars of biodiversity, from genes and species to biome levels. We also have estimates that climate change is expected to threaten extinction of approximately one quarter of all species on land by the year 2050, surpassing even habitat loss as the biggest threat to life on land. Species in the oceans and in freshwater are at great risk, too (Pereira et al. 2010). Ecosystems suffer from a multitude of pressures, including land use change, overexploitation, ocean acidification, pollution, and climate change. As a consequence, the efficiency of ecosystems acting as sinks in removing CO₂ from the atmosphere has decreased significantly and will continue to do so in the future.

On the other hand, healthy, well-functioning ecosystems enhance natural resilience to the adverse impacts of climate change and reduce the vulnerability of people. Sustainable ecosystem management offers many benefits to society, not the least through the maintenance and enhancement of ecosystem services for livelihoods and human well-being, such as clean water and food. It also enhances the capacity to stock carbon. By now, carbon capture and storage in forest ecosystems is receiving particular attention by the scientific community and by national and international policy communities as another essential global ecosystem service.

The downside is that deforestation and forest degradation, mainly in tropical regions, remains the second largest CO₂-emitting source (currently about 15% of total carbon emissions each year) after burning of fossil fuels. More broadly, agriculture, forestry, and other land use (AFOLU) contributed 24% of total GHG emissions in the 2000–2009 period (IPCC 2015), mainly from deforestation, agricultural emissions from soil and nutrient management, and livestock.

At the CFCC conference, the latest evidence across the natural, economic, and social sciences on land-based mitigation issues was presented, often based on case studies. Overall, the scientific community supports the policy of creating financial incentive mechanisms for developing countries to reduce emissions by avoiding deforestation through the REDD (Reducing Emissions from Deforestation and Forest Degradation in developing countries) initiative. A REDD+ approach has been agreed upon at a UNFCCC meeting in Warsaw in 2012 for financing not only forest conservation but also the enhancement of carbon stocks (e.g., through reforestation) and sustainable forest management. Implementation of REDD+ depends largely on synergies between the scientific and policy processes. For example, the development of methods for mapping and monitoring forests and the biomass and carbon stocks within them represents a major contribution from science (Houghton et al. 2010). It will be very important to include REDD+ in the COP21 climate agreement.

Bioenergy has been one sector where controversies in scientific understanding, socio-economic modeling, and policy implementation have been apparent over the last years. The technology most widely used in climate stabilization scenarios of AR5 is bioenergy combined...
with carbon capture and storage (BECCS). Recent studies suggest that in the longer term BECCS may provide larger offsetting potential than afforestation, where the contribution is small once forests reach maturity.

With climate change accelerating, adaptation has become a major task for developing and developed countries alike, with most developing countries woefully lacking the financial and knowledge resources needed for developing and implementing adaptation strategies. Sustainable management of ecosystems has the important co-benefit of providing adaptation solutions (Munang et al. 2013). Research presented at CFCC showed that ecosystem-based adaptation (EBA) approaches, for example maintenance of forest cover to conserve natural hydrological functions, are often more environmentally, economically, and socially effective than adaptation based exclusively on hard infrastructure. Investment in sustainable forest management yields a double dividend related to both adaptation and mitigation.

Policies to enhance ecosystem-based approaches to adaptation and mitigation will need to be based on the best available science and more research. The topics of many sessions and presentations at the CFCC conference read as a long list of the research tasks ahead for the scientific community, in cooperation with policy makers and practitioners. Examples include strategic approaches for enhancing climate change adaptation of species and ecosystems; facilitating adaptive responses involving geographic range shifts, especially at higher latitudes; improving management of planted forests in temperate zones to enhance their contribution to carbon sequestration; and contribution of agroforestry systems to mitigation.

Climate-Smart Agriculture and Sustainable Development

Agriculture is a sector particularly vulnerable to climate change and impacts the livelihoods of the world’s poorest people. This places increased strain on global food systems, especially since expectations for meeting demand for food will change tremendously within the next 40 years and beyond. 13% of the total annual GHG emissions are generated in the agriculture sector. However, with 800 million people still suffering currently from hunger, mainly in South Asia and Sub-Saharan Africa, and the projected continued increase of the world population over the 21st century, substantive increases in food production will be needed throughout the century. Responding to climate change in developing countries will need to be pursued in ways that do not jeopardize, but rather enhance, nationally owned development processes that prioritize food security and poverty reduction, wherein agriculture plays the key role. While accepting this context, agriculture offers options that can provide multiple benefits including mitigation, adaptation, development, and food security. In many instances, choosing the right options in agriculture can allow the management of trade-offs across these requirements (Campbell et al. 2014).

At the CFCC conference, it was advocated that agriculture has a central role to play in strongly reducing greenhouse gas emissions in the next decades. Climate-smart agriculture (CSA) must focus on enhancing agricultural production without an expansion of agricultural land, thus supporting REDD. It also must aim at decreasing emissions from soil and nutrient management and livestock. CSA requires researchers, policy makers, and practitioners to explore solutions combining three pillars: food security, climate change adaptation and mitigation, and underpinning sustainable landscapes and food systems. In this way, CSA represents an (agro)ecosystem-based approach to adaptation strategies.

From a science perspective, climate-smart agriculture is an integral part of sustainable agriculture, representing one of several key areas of sustainable development. CFCC included sessions on sustainable development and more particularly on the new policy instrument of sustainable development goals (SDGs). After an almost three-year process of intergovernmental negotiations following Rio+20 in 2012, governments (at a summit meeting of the UN General Assembly in September in New York) adopted the Post-2015 Development Agenda entitled “Transforming Our World: The 2030 Agenda for Sustainable Development” (Lu et al. 2015; available online). Major environmental concerns addressed in the SDGs framework, such as biodiversity loss, desertification, and climate change, are intertwined both in their causes and solutions. This demonstrates the great usefulness of designing an integrated strategy of inclusive and sustainable development (Griggs et al. 2014). Another climate-change-related 2015 milestone was the adoption of the Sendai Framework for Disaster Risk Reduction (http://www.unisdr.org/), featuring a strong science base, adopted in March at the Third UN World Conference on Disaster Risk Reduction (Sendai, Japan; available online).

Conclusions

Ecosystem-based mitigation and adaptation action must become an integral part of the new Paris climate agreement and of the nationally determined climate action commitments under the agreement. The scientific evidence for the benefits of ecosystem-based approaches was clearly demonstrated at the CFCC conference. However, only an immediate major step change in mitigation and adaptation action across all sectors and
in all domains of society will prevent “the risk of impacts that are severe, pervasive, and irreversible” (CFCC Outcome Statement 2015). The adoption of a new ambitious international climate agreement at COP21 will be a test of political will of all governments. A step change is also needed in science–policy interactions at all levels. In order to base implementation of the nationally determined climate action commitments on sound science, national scientific communities must enhance their engagement with the policy communities and other stakeholders. Through these multi-stakeholder efforts, roadmaps need to be developed on how best to implement climate action at all levels, including on how best to use ecosystem-based approaches to mitigation and adaptation.

Moreover, research communities worldwide must enhance their efforts to generate the knowledge needed for highly efficient mitigation and adaptation solutions, including those related to ecosystem-based approaches. We also need stronger support for internationally coordinated research efforts, such as the World Climate Research Program (WCRP), Future Earth, and the Climate Change, Agriculture and Food Security (CCAFS), and Integrated Research on Disaster Risk Reduction (IRDR) programs.

As the CFCC Outcome Statement puts it, “solving the challenge of climate change requires ambition, dedication and leadership from governments, the private sector, and civil society, in addition to the scientific community. We in the scientific community are thoroughly committed to understanding all dimensions of the challenge, aligning the research agenda with options for solutions, informing the public, and supporting the policy process.”

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