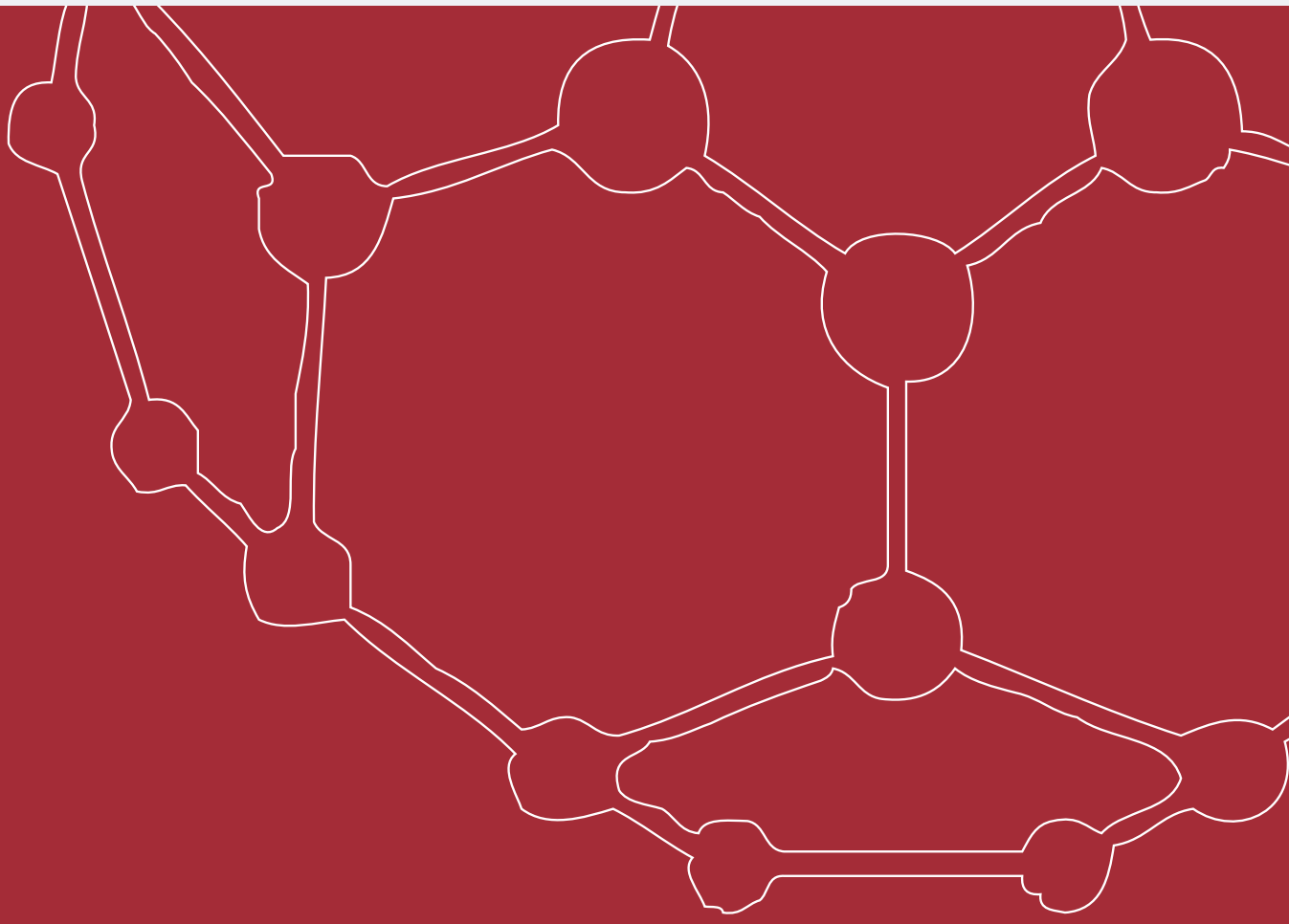
The Role of Terrestrial Carbon in the Climate Change Solution

Where, Why and How - a Short Guide



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The Terrestrial Carbon Group Project
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WHAT IS THE ROLE OF TERRESTRIAL CARBON IN AVOIDING DANGEROUS CLIMATE CHANGE?

Human-induced climate change is caused by the build-up of greenhouse gases in the atmosphere. Greenhouse gases have only two other places to go: the oceans and the terrestrial system (including land and vegetation). This means that, if the world is serious about avoiding dangerous climate change, terrestrial carbon emissions and sequestration must be part of the solution.

Improved management of the world's land (including terrestrial carbon) represents one third of the overall global abatement potential in 2030 (and a half in 2020)[1]. It represents 7Gt CO2e of mitigation in developing countries in 2020, roughly 40% of the 17Gt CO2e of mitigation required globally in 2020[2]. Realising this abatement potential will require the creation of new incentives in the developing world for maintaining existing terrestrial carbon (eg. avoiding deforestation and forest degradation) and creating new terrestrial carbon (eg. afforestation, reforestation, and better soil management). This can start now with "REDD+"[3] and expand later to cover Agriculture, Forestry and Other Land Uses (AFOLU).

Putting in place an effective new incentive system requires taking a long-term view of where we are going and where we need to be. It means weighing up trade-offs and making policy choices that will guide us not only into the first period of a post-Kyoto Protocol world, but also through the next thirty years. It means starting now what is immediately possible and building transition pathways to what is ultimately necessary. Lastly, it means prioritising essential functions and mitigation actions. In making their judgements, decision makers need to be well informed. The aim of this document is to provide concise answers to some of the most pertinent policy questions related to terrestrial carbon, including:

- Where is the terrestrial carbon?
- How much terrestrial carbon is at risk?
- How can we move away from "business as usual" to a safer trajectory?
- How can we measure and monitor terrestrial carbon?
- How can we make the transition from REDD+ to AFOLU?
- What work needs to be done now and in the future?
- What can Copenhagen deliver?

It is not enough to pay lip service to the importance of terrestrial carbon. The international community needs to signal in Copenhagen that it is prepared to ramp up its action, and to ramp it up now. This requires the provision of adequate incentives to tackle the emissions and harness the potential of terrestrial carbon sequestration at a scale large enough to be meaningful for atmospheric greenhouse gas concentrations. It requires providing support for countries to get "ready" to operate within an incentive system, as well as rewarding those countries that have already taken steps down this path. There is nothing to stop nations committing to a comprehensive framework to unleash this potential. Imperfections or uncertainty are no excuse for inaction or short sightedness, but rather a reason for vision and innovation.

Where is the terrestrial carbon?

Forests in the non-Annex I countries contain 538 Gt of carbon.[4] This equates to 40 years of annual anthropogenic greenhouse gas emissions at 2004 rates. By region, South and Central America, Africa, and Asia & Oceania are all significant stores of forest carbon, although South American forests store the greatest volume with nearly twice as much as Asian & Oceanian forests and one-third more than African forests.

There is more to forest carbon than vegetation. By carbon pool, 57% of total forest carbon in non-Annex-I countries is in the vegetation and 43% in the soil. By region, forests in Asia & Oceania hold greater volumes of carbon in their soil than their vegetation, while for African and South American forests the opposite is true; forests in Central America hold equal volumes.

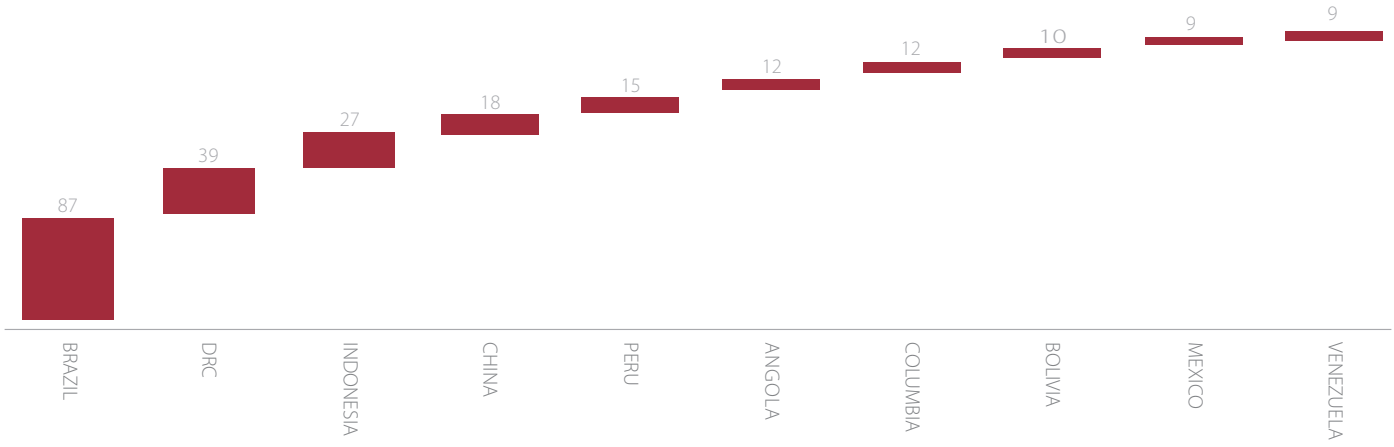
[1] Pathways to a Low Carbon Economy: Version 2 of the Greenhouse Gas Abatement Cost Curve, McKinsey & Company 2009. Based on calculation of abatement potential at a cost of less than 60€/tCO2e.

[2] McKinsey & Company analysis for Project Catalyst in "Towards the inclusion of forest-based mitigation in a global climate agreement" (Working Draft May 2009). Based on calculation of abatement potential at a cost of less than 60€/tCO2e. McKinsey & Company analysis for Project Catalyst in "Scaling up Climate Finance: Finance briefing paper" (September 2009). Required mitigation is calculated as the difference between business as usual greenhouse gas emissions and the level of emissions required to stay on a pathway to stabilising greenhouse gas concentrations at 450ppm.

[3] Reducing Emissions from Deforestation and forest Degradation plus conservation and sustainable forest management and enhancement of forest carbon stocks in developing countries.

[4] The figures reported relate to terrestrial carbon (vegetation and soil) in the 139 non-Annex-I countries analysed in Terrestrial Carbon Group Project (2009a).

Figure 1. Non-Annex-I countries with the highest volume of volatile forest carbon (GtC)



Top 10 represent 66%

Assuming that 100% of carbon stored in vegetation and 25% of carbon stored in the soil would be emitted in the event of land use change, maximum emittable forest carbon volumes can be estimated. These amounts are referred to here as "volatile carbon". If all forested land in non-Annex-I countries were deforested, 363 Gt of carbon would be emitted.

By region, this would be 169 GtC from South and Central American forests, 119 GtC from African forests, and 75 GtC from Asian & Oceanian forests.

However, it is necessary not just to consider carbon volumes in aggregate, but also on a disaggregated basis to both understand where the future limits and future potential for deforestation may lie, and by extension to gain some insight into the implications of different proposals for the structure of a future REDD+ mechanism.

Volatile forest carbon is highly concentrated in a relatively small number of nations (with a variety of forest profiles). Specifically, ten countries account for 66% of this total volatile forest carbon. This includes historically low rate deforesters with medium or high forest cover (The Democratic Republic of the Congo, Peru and Colombia), as well as China (see Figure 1).

Forests are undoubtedly an important source and sink for carbon emissions. However, there is more to terrestrial carbon than forests. Other land types also can and do house considerable volumes of carbon.

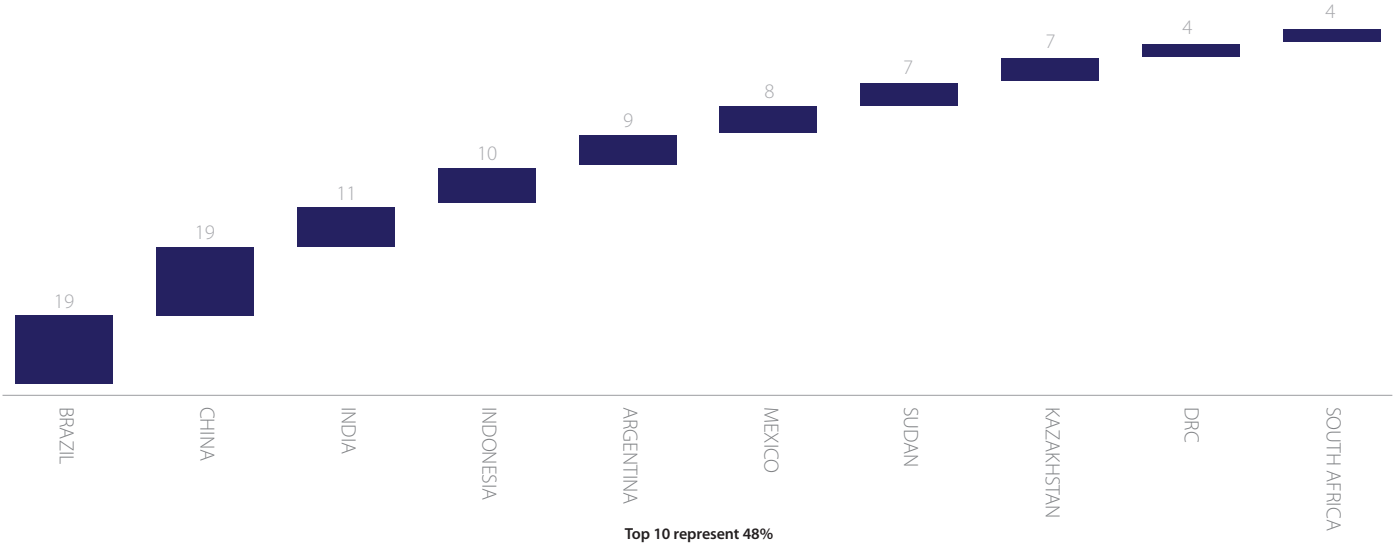
We estimate that there is more carbon stored in non-forested land than forested land in non-Annex-I countries. Non-forested land contains 571 GtC and forested land contains 538 GtC (1,109 GtC in total). Also, while forest carbon is split more evenly between vegetation and soil, non-forest carbon is predominantly stored in the soil.

As in the case of volatile forest carbon volumes, the majority of volatile carbon in non-forested land is concentrated in a limited number of countries. Just ten countries account for 48% of volatile carbon in non-forested land (Figure 2), a slightly lower percentage than for forested land.

Finally, five of the countries in the top ten for volatile carbon in non-forested lands do not appear in the equivalent top ten of volatile carbon on forested lands. These countries are India, Argentina, Sudan, Kazakhstan, and South Africa.

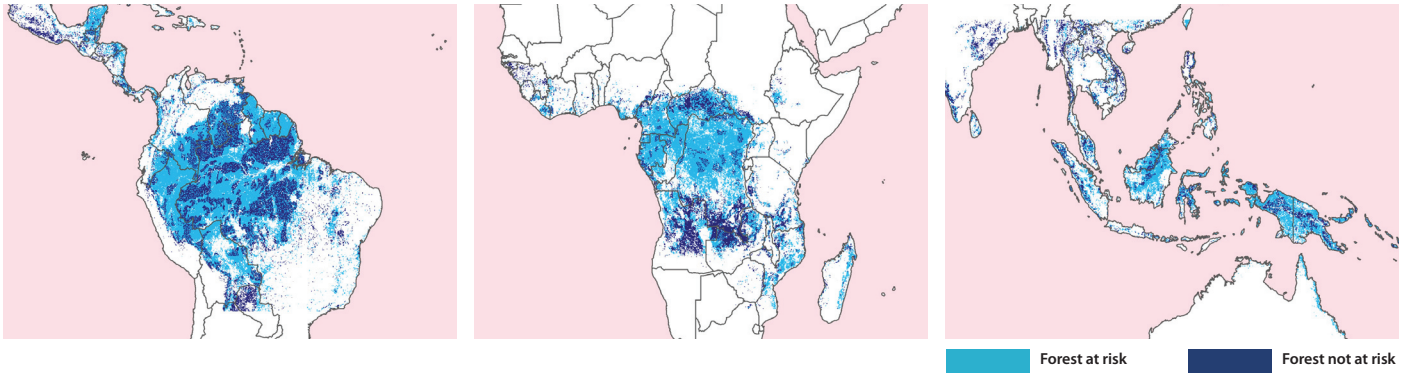
Based on this analysis, a REDD+ system that is restricted to avoided emissions of forest land is comparatively better for South and Central America than for Africa and Asia & Oceania, and vice versa. The distribution of benefit would be different again if the system included conservation, sustainable forestry management and sequestration through afforestation and reforestation(A/R), or if other land uses were included.

Figure 2. Non-Annex-I countries with the highest volume of volatile non-forest carbon (GtC)



Top 10 represent 48%

Figure 3. Tropical forest at risk of deforestation in a business as usual world – base case



How much terrestrial carbon is at risk?

The Terrestrial Carbon Group uses a "3 filters" methodology to determine how much and where terrestrial carbon is at risk of emission into the future based on economic, biophysical and legal factors in the absence of an incentive system – a "business as usual" world[5]. Taking into account carbon emission from deforestation alone, in a "business as usual" world, 63% of tropical forest is at risk of deforestation over the long term (Figure 3 and Table 1).

This deforestation would result in emissions of 176 GtC, equivalent to an increase in atmospheric carbon dioxide of 82 ppm. Whilst this analysis is indicative only, it does reveal that the continent at risk of losing the greatest proportion of its remaining tropical forests is Africa (67%), followed by Latin America (63%) and Asia (57%). This equates to 868 million hectares, half in Latin American tropical forests, a third in African and the remaining 15% in Asia. In other words, although rates of deforestation vary substantially today, the future risk of deforestation is high in all three regions (see Table 1).

Table 1. Base case estimates of business as usual tropical deforestation areas and emissions

Business as Usual	Deforestation of Tropical Forest (over long-run)		Emissions from Deforestation of Tropical Forest (over long-run)	
(in the 73 non-Annex I countries analysed)	m ha	%	Gt C	%
Asia	128.2	57%	29.6	64%
Africa	298.9	67%	58.2	71%
Latin America	441.3	63%	87.8	64%
Total	868.4	63%	175.5	66%

Even assuming global deforestation remains constant, future development pressures and the "migratory" potential of deforestation means that potential emissions in each country, regardless of recent or current national deforestation, need to be taken into account. For example, if historically low deforesters are excluded, then at least 85Gt of volatile carbon in these countries will be left outside of the incentive system and it is likely these countries will face increasing deforestation pressure in the future, particularly as other countries potentially "run out of forest".

To address this, an international agreement can foster broad participation by being applicable to developing nations with different terrestrial carbon circumstances, for example high forest cover and low deforestation rates and vice versa.
One way to do this is to know what a reasonable "business as usual" scenario would look like and to use this information to set appropriate reference emission levels (RELs). This can be done using a variety of existing tools.[6]

How can we move away from "business as usual" to a safer trajectory?

Terrestrial carbon is a major source of greenhouse gas emissions and represents a critical opportunity for mitigation through emissions reduction and sequestration due to current land use and levels of land use change.

The international climate change response must provide short-term and long-term incentives in exchange for reductions in emissions of terrestrial carbon from land use and increases in the sequestration of atmospheric carbon in the terrestrial system.

For an incentive system to meet the criteria of generating "real" mitigation at scale, over the long term, it needs to:

- Be credible as well as flexible enough to allow a mix of complementary approaches such as bilateral deals, multi-lateral arrangements, UNFCCC governed agreements and market and non-market based approaches; and,
- Be expandable and adaptable to the later inclusion of other land uses (and gases) as future knowledge, technologies and capacities allow.

To enable all countries to participate and get up to speed as quickly as possible, it is increasingly recognised that a phased approach is required, starting with planning and early action, supported by interim measures of payment for performance. This could involve both financial and technical assistance, and build on the bilateral and multilateral initiatives already underway, noting that there are around 40 developing countries now engaged in REDD+ strategy development and demonstration activities.

Later phases would deliver greater incentives based on certified performance as a country moves to full implementation. The final phase would see payment tied to a certified product (eg, certified emissions reductions / sequestration).

Generating the economic impetus for such action will inevitably require a mix of sources of funding including international funds, and international trading – under bilateral, multilateral and/or global arrangements - where the unit of product is based upon emissions reduced or carbon sequestered[7]. To be scalable and sustainable over the long run, long-term effective participation of both the public and private sectors in both developing and developed countries will be required.

[5] Terrestrial Carbon Group Project (2009b)
[6] Terrestrial Carbon Group Project (2009c)
[7] Terrestrial Carbon Group Project (2009d).

In practical terms, to achieve scale and sustainability, the system must be flexible and take into account evolving capabilities and resources over time. It must be capable of delivering the necessary mitigation potential from the AFOLU sectors, starting with REDD+.

Any system will only be sustainable if its participants have confidence in it and ownership of it. To create this confidence, there must be a strong international treaty which sends a clear signal by including deep emission reduction targets for developed countries to create the sustained demand for the product. Simplified rules must be agreed to reward those countries that have taken early action on terrestrial carbon management even before the detailed rules are known. To further maintain this momentum, financial and technical support is needed for basic "building blocks" – to address gaps in human and technical capacity, information accessibility, infrastructure, and expertise, as well as to ensure credibility and transparency of the system.

Once a clear international signal has been sent regarding the size and nature of incentives, the international community would need to ensure the stable, long-term disbursement of funds. This includes providing the long-term mandate and financing to finish building the international institutional infrastructure necessary to guide and coordinate the implementation of terrestrial carbon mitigation at the required scale over the next thirty years.

How can we measure and monitor terrestrial carbon?

Under a global agreement on incentives for terrestrial carbon management, national level measuring and monitoring (M&M) frameworks will be needed to ensure that real, quantifiable and comparable carbon emission reductions and sequestration take place. This will involve the production and reporting of information that can be audited, certified and compared with information from other nations and be consistent over time. It will also require ongoing efforts to optimise the accuracy of carbon and other greenhouse gas measurement and monitoring.

Today, it is technically possible to measure and monitor all major carbon pools using existing M&M methods and systems. However, many developing countries have limited data-gathering capacity and limited access to reliable existing datasets and measurement methods. Building capacity for monitoring, reporting and verification (MRV) for all major land use classes requires cost-effective, widely available tools and methods and coherent guidance and technical assistance. The optimal delivery of monitoring systems will require a commitment of resources – both financial and technical – and expanded coordination within the research community. The good news is that a number of developed and developing countries have, or are building, national M&M systems (including – among developing countries – Brazil, Guyana, India, Indonesia, Mexico, and Papua New Guinea).[8]

To continue this expansion in national-level capacity for terrestrial carbon accounting, the international community, including both developed and developing nations, can contribute by actions such as:

- Increased clarity and consistency of definitions as well as land cover and land use classifications;
- Free access to the most commonly used types of remote sensing data;
- Long-term investment in more cost-efficient and transparent data gathering; and,
- Increased coordination and sharing through a common data archive.

At present, research is commonly organised around major land classes – forests, croplands, grasslands and drylands, and wetlands and peatlands. There will need to be a shift to more integrated and multi-disciplinary research in order to enrich the technical basis for effective terrestrial carbon management and measurement under AFOLU[9]. As Table 2 shows, different land uses can require different types of M&M methods.

Table 2. M&M requirements for different land uses

	What is covered	What is the M&M focus?	What accuracy is required?
RED	Deforestation	Carbon in the woody above-ground pool, except for forests on peat soils	Existing forest data, historical images, allometric equations and models, access to medium-high resolution remote sensing imagery
REDD	Deforestation and degradation	Similar to RED, as well as more subtle changes in carbon in the non-woody above-ground pool	More intensive field measurements, higher resolution remote sensing imagery
REDD+	Deforestation, degradation, conservation, sustainable forestry management, forest carbon stock enhancement	Similar to REDD, as well as carbon in above and below ground biomass, litter, dead wood, soil organic matter and harvested wood products	Emphasis on quality of information and collection procedures in forest management
AFOLU	Agriculture, Forestry and Other Land Use	Similar to REDD+, as well the inclusion of all pools and all greenhouse gases	Refined land use classification system, comprehensive models, historical information on non-forest land use categories, land management information

It is likely that in many countries, national M&M systems will begin with tracking changes in carbon levels associated with deforestation, and increase over time to collect information on other land uses and gases.

How can we make the transition from REDD+ to AFOLU?

There is more to terrestrial carbon than forests, and more to mitigating climate change than avoiding deforestation. While forests are an important place to start, there needs to be a transition to an effective long-term terrestrial carbon strategy. The question is - how?

Ideally, commitment will be made in Copenhagen to the full inclusion of all terrestrial carbon pools that interact with the atmosphere at timescales less than centuries, and all land uses. This would include an overarching framework for a consistent and timebound transition pathway that starts with REDD+ and moves to AFOLU as soon as possible. An incentive system would be operating by 2013 at the latest, and there would be a timetable for the future inclusion of other aspects of terrestrial carbon, that is, the full inclusion of Agriculture, Forestry and Other Land Uses (AFOLU) in a comprehensive system.

[8] Terrestrial Carbon Group Project (2009e)
[9] Terrestrial Carbon Group Project (2009f)

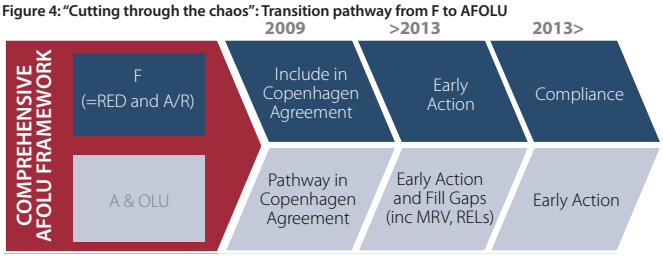
The transition pathway is the means of getting from REDD+ to AFOLU (see Figure 4). There are steps along the path from the "Readiness" through to "Full implementation". The end goal is a system that delivers the maximum climate-related impact by effectively incentivizing sustainable management of all land use classes.

Full implementation of all the essential functions and organisations required for a comprehensive system will require an evolutionary process, planning for which means taking a long-term view. It means considering not only the systems to be established today, but how these systems will be compatible with the later inclusion of other land uses. For example:

- The functions and institutions (including reserves, registers and exchanges) originally established for REDD+ will need to be "upwardly compatible" with the later inclusion of agriculture and other land uses;
- Common data requirements of different land uses should be determined to allow the coordination of data gathering and interpretation in these areas, even if one land use will not be phased into the accounting until after another. This will avoid duplication and maximise effectiveness of the resources available; and,
- Credible Quality Assurance / Quality Control procedures will be required to ensure that we can form a global picture of emissions and sequestrations from the covered land use sectors.

The international community will need to work together to make the transition. The first step is the inclusion of forests and peat lands. The second is the provision of a clear signal and timeline for the future inclusion of other land uses.

Figure 4: "Cutting through the chaos": Transition pathway from F to AFOLU



What work needs to be done now and in the future?

In the three years between Copenhagen and 2013, a coherent and integrated programme of work must be undertaken by the international community. This is the only way we can ensure that adequate infrastructure is in place to deliver real mitigation, by the time it is required, at scale, in a manner that is sustainable and efficient. There are many steps to readiness, the majority of which will require some form of enabling institutional and legislative framework. These frameworks must be built by 2013, but with an eye to the thirty years beyond.

Legislative Framework

A coherent, strong and effective regulatory platform is necessary to (i) implement national and sub-national policies and measures, and (ii) stimulate changes in the use of forest and land resources that achieve avoided emissions and increased sequestration. Creating this platform involves reviewing existing laws and drafting new regulations to establish terrestrial carbon registers, exchanges, dispute resolution and enforcement mechanisms, and regulatory oversight.

Key elements to consider as part of the legal framework include:

- What is the internationally agreed definition of the production unit (credit)?
- How will credits earned at a national level be allocated to subnational or project-level activities and how will these activities relate to baseline crediting?
- What mechanism(s) will be used to resolve competing interests in land and resources and any uncertainty in hierarchy between different types of interests?
- Should credits or lands be set aside for the purposes of ensuring long term maintenance of the carbon stock through a buffer or pool?
- What types of powers will the responsible institution governing the national system have in terms of monitoring and enforcement?

It is possible to learn from early experience and precedents. In some cases, modification of existing, rather than the creation of new legislation may be required. Legal and policy frameworks are being reviewed, implemented or at least considered in a range of developing forest countries. For example, Indonesia has passed national legislation intended to provide a comprehensive model for REDD activities. [10]

Institutional framework

At the international scale, a key step to "readiness" is the establishment of an integrated international framework to maximize the potential of REDD+ / AFOLU, to allow the aggregation of emissions date to monitor global trends, and to control international leakage. Another step is the creation of a central organisation(s) to act as coordinator and provider of scientific and capacity-building support and stable long term funding. It needs to be given a clear mandate to build capacity in order to move away from our current ad hoc reaction towards a coordinated and long-term response.

At the national scale, institutions are needed to establish clear governance frameworks between national and regional governments and to create credible and transparent systems and institutions to certify and audit the production of carbon mitigation as well as to coordinate with international institutions. This does not necessarily mean new institutions are required. Circumstances will vary from country to country depending on current capacity, financial resources and whether responsibility for functions can be taken on by existing organisations without conflicts of interest.

In addition to precedents for many of the types of institutions required at the international and national level, it is also possible to again learn from early experience. Implementation of a terrestrial carbon system will require a high level of technical, scientific and inter-stakeholder cooperation, capacity building and support. At all scales, there is work already being done to lay down this foundation through the efforts of forest countries with support from developed countries. Important work is also being done by the World Bank's Forest Carbon Partnership Facility, UN-REDD, and many civil society organisations and academics. The next step is to ensure greater coordination between and across these scales of implementation.

[10] Terrestrial Carbon Group Project (2009g)

WHAT CAN COPENHAGEN DELIVER?

Article 3 of the United Nations Framework Convention on Climate Change binds Parties to take precautionary measures "to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures". Action on land use (including terrestrial carbon) represents one third of the overall abatement potential in 2030[11]. There is nothing to stop nations committing to comprehensive framework to unleash this potential. Imperfections are no excuse for inaction or short sightedness, but rather a reason for vision and innovation. This is part of implementing a framework that guides us not only through the next five-year commitment period but also through the next thirty years.

This framework would:

1. **Include incentives for carbon capture (reforestation, soil management, etc) and carbon storage (avoided emissions from deforestation, forest degradation, etc) in forests and peatlands, starting 2013.**

2. **Commit to developing the technical capability to robustly include greenhouse gas emissions and sequestration from agriculture and other land uses as soon as possible (aiming for 2013).**

3. **Agree simplified rules to reward those countries that have taken early action on terrestrial carbon management even before the detailed rules are known.**

4. **Provide the long-term mandate and financing to finish building the international institutional infrastructure necessary to guide and coordinate the implementation of terrestrial carbon mitigation at the required scale over the next thirty years.**

There is room for methodologies and techniques to improve, and over time they will. Action on terrestrial carbon should adapt to these improvements but not be delayed or held hostage by indecision.

In addition to a global deal, nations can forge ahead through bilateral and multi-lateral agreements and partnerships. These partnerships can help put in place the building blocks we urgently need, allowing the world to respond at the scale required in the time available. Fundamentals such as national carbon accounting systems and large-scale demonstration activities are not controversial or policy-dependent.

This is not about choosing between action in one country or sector over another. We humans simply have to do everything we can, everywhere we can, as soon as each action is feasible, to decarbonise the global economy.

The Terrestrial Carbon Group supports the urgent case for a clear international signal on REDD+, so that the essential functions and associated institutions can be ready to deliver terrestrial carbon mitigation as soon as possible, and, if a global agreement is reached, by the start of the next commitment period (2013).[12]

The international community must also provide a signal and timeline for the future inclusion of agriculture and other land uses. This the only way we can ensure that adequate infrastructure is in place to deliver real mitigation, at scale, in a manner that is sustainable, efficient and immediate.

[11] Pathways to a Low Carbon Economy: Version 2 of the Greenhouse Gas Abatement Cost Curve, McKinsey & Company 2009. Based on calculation of abatement potential at a cost of less than 60€/tCO2e.
[12] Terrestrial Carbon Group Project (2009d)

Prepared by Fiona McKenzie and Amber Childress
This document is a compilation of the work of the Terrestrial Carbon Group Project for 2009
For more information please email: fiona.mckenzie@terrestrialcarbon.org

REFERENCES

McKinsey & Company, 2009. *Pathways to a Low Carbon Economy: Version 2 of the Greenhouse Gas Abatement Cost Curve.* McKinsey & Company.

Project Catalyst, 2009. *Scaling up climate finance: Summary of finance briefing paper, September 2009.* Climate Works Foundation.

Terrestrial Carbon Group Project, 2009a. *Distribution of Terrestrial Carbon Across Developing Countries. Terrestrial Carbon: Forest and Non-Forest; Vegetation and Soil. Policy Brief 1, June 2009.* Terrestrial Carbon Group.

Terrestrial Carbon Group Project, 2009b. *Estimating Tropical Forest Carbon at Risk of Emission from Deforestation Globally: Applying the Terrestrial Carbon Group Reference Emission Level Approach. Policy Brief 3, June 2009.* Terrestrial Carbon Group.

Terrestrial Carbon Group Project, 2009c. *Tools for Setting Reference Emission Levels: a review of existing tools that can be used to set a benchmark for rewarding reduced emissions and increased sequestration of greenhouse gases in the terrestrial system. Policy Brief 2, June 2009.* Terrestrial Carbon Group.

Terrestrial Carbon Group Project, 2009d. *Assessment of the Functions, Institutions and Transition Pathways for a System to Deliver Terrestrial Carbon Mitigation (REDD+ to AFOLU).* Terrestrial Carbon Group.

Terrestrial Carbon Group Project, 2009e. *Measuring and Monitoring Terrestrial Carbon as Part of "REDD+" MRV Systems. Policy Brief 5, October 2009.* Terrestrial Carbon Group.

Terrestrial Carbon Group Project, 2009f. *Roadmap for Terrestrial Carbon Science: Research Needs for Carbon Management in Agriculture, Forestry and Other Land Uses.* Terrestrial Carbon Group.

Terrestrial Carbon Group Project, 2009g. *Legal and Institutional Foundations for the National Implementation of REDD. Policy Brief 4, June 2009.* Terrestrial Carbon Group.