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Planting the Foundations of a Post-2020 Land Sector Reporting and Accounting Framework

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ABSTRACT

Planting the Foundations of a Post-2020 Land Sector Reporting and Accounting Framework

Land management faces a series of daunting challenges in the 21st century. These include contributing to the global mitigation effort and adaptation needed to prevent dangerous climate change, while providing enough food for a population of 9 billion by 2050 as well as shelter and livelihoods for rural populations and various ecosystem services. The existing mitigation reporting and accounting arrangements for the land sector are complex, not applicable to all Parties, and provide limited scope for pursuing more cost-effective accounting approaches that would enable developing countries to address conflicting policy objectives such as addressing climate change while increasing agricultural output. This paper has two aims. The first is to lay out possible elements of a long-term vision for the post-2020 reporting and accounting framework for emissions and removals from the land sector, building on existing experience with reporting and accounting as well as previous studies. The second is to identify possible steps that could be taken at COP 20 in 2014, COP 21 in 2015, and in 2016-2020 to put Parties on a pathway towards realising this vision.

JEL classification: F53, O44, Q23, Q24, Q54, Q56

Keywords: UNFCCC, climate change, mitigation accounting, land use, land use change, forestry

RÉSUMÉ

Jeter les bases d'un cadre de déclaration et de comptabilisation post-2020 dans le secteur foncier

La gestion des terres est confrontée à une série de défis redoutables au XXI^e siècle. Elle doit en effet contribuer à l'effort mondial d'atténuation et d'adaptation nécessaire pour prévenir une évolution dangereuse du climat, tout en assurant une production alimentaire suffisante pour nourrir 9 milliards de personnes en 2050, et en fournissant un habitat et des moyens de subsistance aux populations rurales ainsi que divers services écosystémiques. Les dispositifs existants de déclaration et de comptabilisation des mesures d'atténuation dans le secteur foncier sont complexes, ne sont pas applicables à toutes les Parties et n'offrent guère de possibilités de mettre en œuvre des méthodes comptables plus efficaces et économes, qui permettraient aux pays en développement de concilier des objectifs contradictoires consistant, par exemple, à faire face au changement climatique tout en augmentant leur production agricole. Ce document a deux objectifs. Le premier consiste à énoncer les éléments possibles d'une vision à long terme du cadre de déclaration et de comptabilisation des émissions et des absorptions du secteur foncier, en s'appuyant sur l'expérience acquise en matière de déclaration et de comptabilisation ainsi que sur des études antérieures. Le second est de définir les mesures qui pourraient être prises à la COP 20 en 2014, à la COP 21 en 2015 et en 2016-2020 afin d'indiquer aux Parties la voie à suivre pour concrétiser cette vision.

Classification JEL: F53, O44, Q23, Q24, Q54, Q56

Mots-clés: CCNUCC, changement climatique, comptabilité en matière d'atténuation, utilisation des terres, changement d'affectation des terres, forêts

FOREWORD

This document was prepared by the OECD and IEA Secretariats in 2014 in response to a request from the Climate Change Expert Group (CCXG) on the United Nations Framework Convention on Climate Change (UNFCCC). The CCXG oversees development of analytical papers for the purpose of providing useful and timely input to the climate change negotiations. These papers may also be useful to national policy-makers and other decision-makers. Authors work with the CCXG to develop these papers in a collaborative effort. However, the papers do not necessarily represent the views of the OECD or the IEA, nor are they intended to prejudge the views of countries participating in the CCXG. Rather, they are Secretariat information papers intended to inform Member countries, as well as the UNFCCC audience.

Members of the CCXG are Annex I and OECD countries. The Annex I Parties or countries referred to in this document are those listed in Annex I of the UNFCCC (as amended by the Conference of the Parties in 1997 and 2010): Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, the European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, the Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom of Great Britain and Northern Ireland, and the United States of America. As OECD member countries, Korea, Mexico, Chile, and Israel are also members of the CCXG. Where this document refers to “countries” or “governments”, it is also intended to include “regional economic organisations”, if appropriate.

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Executive summary

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are currently preparing intended nationally determined contributions for the post-2020 period, as part of the new climate change agreement to be adopted at the twenty-first Conference of the Parties to the UNFCCC (COP 21) in Paris in 2015. The reporting and accounting¹ framework for these post-2020 nationally determined contributions has yet to be agreed. An important part of this reporting and accounting framework will be how greenhouse gas (GHG) emissions and removals from agriculture, forestry and other land use (AFOLU, hereafter referred to as the “land sector”) are treated.

The Intergovernmental Panel on Climate Change (IPCC) estimates that anthropogenic GHG emissions from the land sector are currently around 10-12 GtCO₂-eq per year – the second largest source of anthropogenic GHG emissions after the energy sector. Further, non-CO₂ emissions from agricultural activities such as enteric fermentation in livestock, manure management, rice cultivation and agricultural soils now exceed CO₂ emissions from deforestation and other land use changes. Mitigation and adaptation in the land sector are therefore essential if the goal to limit the rise in global average temperature to below 2 °C above pre-industrial levels is to stay within reach, and the worst impacts avoided.

Several sets of arrangements currently exist for reporting and accounting of anthropogenic GHG emissions and removals from the land sector. These include reporting via GHG inventories under the Convention, reporting and accounting for land use, land-use change and forestry (LULUCF) activities by Annex B Parties² under the Kyoto Protocol (KP), and recognition of reduced emissions from deforestation, forest degradation and related activities (REDD+) in developing countries. Under the KP, special accounting rules have been established for LULUCF activities while non-CO₂ emissions from agriculture are treated the same way as other inventory categories for national accounting purposes. Project-level reporting and accounting methodologies have also been developed under the Clean Development Mechanism (CDM) and by the voluntary carbon markets.

The LULUCF part of the land sector has some special features that distinguish it from other sectors such as agriculture, energy, transport, industry and waste. It is particularly difficult to separate anthropogenic from natural emissions and removals for LULUCF. The effects of past management decisions can have a particularly strong influence on emissions and removals from forests, since they determine the age-class structure and harvesting cycles of forests – this is known as the “legacy effect”. Removals of CO₂ by vegetation and soils are not necessarily permanent, and reversals can be triggered by natural disturbances or human activities. Further, uncertainties tend to be high and some of the emissions are the result of essential activities such as food production. Consequently, the existing reporting and accounting arrangements are complex, not applicable to all Parties, and provide limited flexibility for pursuing more cost-effective accounting approaches that would enable developing countries to address potentially conflicting policy objectives such as addressing climate change while increasing agricultural output.

Possible elements of a long-term vision for land sector reporting and accounting are presented in this paper. The vision is of a multi-dimensional land sector reporting and accounting framework that is applicable to all countries and increases in comprehensiveness over time. The long-term vision builds on the conclusions of other recent studies in this area and respects the special features of the LULUCF part of the land sector outlined above. The overarching objective of the reporting and accounting framework is to

¹ In this paper, reporting refers to the measurement and reporting of information on GHG emissions and removals, and is largely technical in nature. Accounting refers to what counts towards the achievement of mitigation commitments and how implementation of commitments is tracked, and is more political in nature.

² Annex B Parties are Annex I Parties with commitments under the Kyoto Protocol.

build trust between Parties by tracking progress in implementation of mitigation contributions in the land sector. The possible elements identified are:

Generic elements (relevant to all sectors)

- Use of IPCC 2006 Guidelines by all Parties (with flexibility for least developed countries and small island developing states) to measure and report information on key sources and sinks, with different Parties using different tiers for different sources and sinks, according to capacity.
- Increasing quality and accuracy of reporting for land sector sources and sinks (i.e. using higher IPCC tiers for key categories where possible).
- Provision of up-front information alongside intended nationally determined contributions that promotes transparency, clarity and understanding.
- Flexibility in some aspects of the reporting and accounting framework and acceptance of different entry points for different countries, to accommodate the different national circumstances and capacities of countries.
- Focus on cost-effective reporting and accounting.
- Recognition of need for means of implementation to increase reporting and accounting capacity in developing countries.

Land-specific elements (relevant to the land sector only)

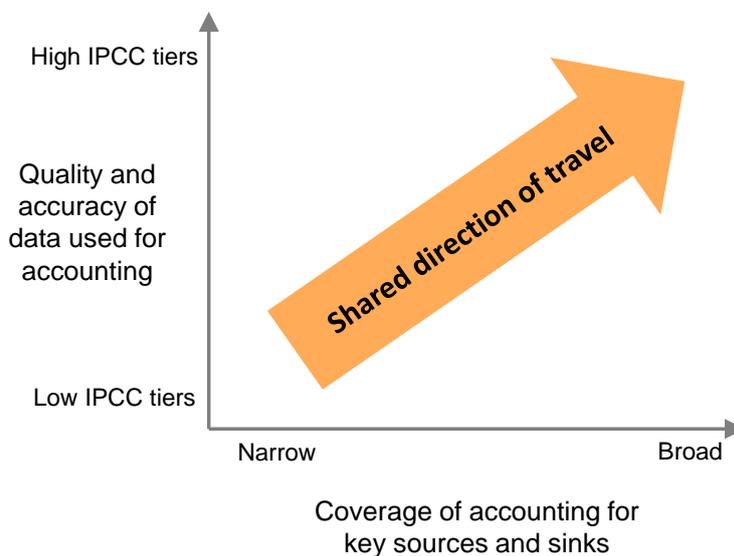
- Increasing coverage over successive cycles of nationally determined contributions for accounting for anthropogenic sources and sinks (with existing accounting of non-CO₂ emissions from agriculture to continue for Annex B Parties).
- Provisions to address age-class structure effects in forests and the risk of natural disturbances and reversals of sequestered carbon from forests and other land sinks.
- Use of a “once in, always in” rule for coverage of sources and sinks.
- Accommodate mitigation contributions expressed relative to reference levels or using intensity metrics relating to agriculture, forestry and soils, with a view to providing cost-effective accounting options that take into account national circumstances.
- Technical assessment of reference levels where appropriate to increase confidence in the baselines against which progress is tracked.
- Reporting of qualitative information on a Parties’ vision for the land sector and the multiple benefits of policies and environmental and social safeguards (where applicable), to complement the quantitative accounting framework.

The long-term vision can be depicted as a multi-dimensional matrix, with various dimensions for reporting and accounting. Two of the most important dimensions could be the coverage of accounting for key sources and sinks and the quality and accuracy of data used for accounting (Figure ES.1). Parties could agree shared direction of travel for all Parties over time, in terms of increasing the coverage of accounting for key sources and sinks and increasing the quality and accuracy of data used for accounting. Countries in a position to do so would be expected to advance over time towards higher IPCC tier approaches for estimating emissions or removals from key categories.

Countries with low capacity for measuring and reporting could start by reporting GHG emissions from key sources and sinks using the IPCC Tier 1 approach, which is the simplest approach and uses default

emissions factors. Increasing use of country-specific emissions factors and remote sensing technologies and other techniques could help to increase the accuracy of land sector data. Capacity building would be needed to assist low-capacity countries to increase their reporting and accounting coverage over time.

Figure ES.1: A shared direction of travel for land sector accounting



This paper outlines possible short-term steps for COP 20, COP 21 and 2016-2020 that could put Parties on a pathway towards realising the long-term vision. Some Parties may choose to include mitigation (and potentially also adaptation) actions in the land sector as components of their intended nationally determined contributions under the Ad hoc Working Group on the Durban Platform for Enhanced Action (ADP). The nationally determined contributions that Parties choose to put forward could include economy-wide contributions covering the land sector, sector-specific goals, goals relative to baselines or reference levels, project-level actions, and individual policies and measures. At COP 20, Parties could agree to create a formal work stream to discuss post-2020 land sector accounting issues, and decide the up-front information to be provided alongside land sector contributions.

At COP 21 in 2015, a set of foundations for post-2020 land sector reporting and accounting could be agreed that put Parties on a pathway towards the possible long-term vision outlined above. The foundations for reporting could include agreement by all parties to use IPCC 2006 Guidelines for reporting GHG inventories of anthropogenic emissions and removals. The foundations for accounting could include: agreement to expand the coverage of land sector accounting over time, with a view to achieving broad coverage of key categories of anthropogenic sources and sinks in the land sector in all countries; that the “once in, always in” accounting rule is to be applied in the post-2020 period; that both emissions and removals are to be accounted for; and that there are to be technical assessments of reference levels (where called for by the type of contribution or as part of technical corrections, e.g. for age-class effects in forests) to increase confidence and build trust.

Elaboration of technical details relating to the land sector reporting and accounting framework could be undertaken in the period 2016-2020. Issues remaining to be addressed after COP 21 could include: the possible development of guidance for reference levels and intensity-based approaches for agriculture, as ways to deal with legacy effects and address multiple policy objectives; treatment of removals due to natural disturbances or indirect human effects; the approach to be used for identifying anthropogenic GHG emissions and removals; and the potential role of the land sector in market and non-market mechanisms.

Millions of people in rural communities also depend on agriculture and forestry for their livelihoods. Therefore in addition to the accounting system, which focuses on tracking progress towards quantitative mitigation commitments, Parties could be encouraged to develop and report qualitative information on holistic landscape management strategies and benefits of actions in areas such as environmental and social safeguards (as currently applied under the REDD+ framework), climate-smart agriculture, and ecosystem-based adaptation. Consistent with their type of nationally determined contribution, Parties could also choose to deal with these competing demands by focussing on efficiency or productivity, such as GHG emissions per unit of agricultural output.

1. Introduction

Land management faces significant challenges in the 21st century. These include contributing to the global mitigation effort needed to prevent dangerous climate change, while providing enough food for a population of 9 billion by 2050 as well as shelter and livelihoods for rural populations and various ecosystem services. Risk multipliers include increasing land degradation and perturbed cycles of nitrogen, phosphorous and other nutrients, as well as growing water stress in many regions and other climate-related impacts.

There is a constant, natural exchange of carbon between the land, the atmosphere and the oceans. For hundreds of years human activities have interfered with this natural cycle resulting in a significant net transfer of carbon from the land stock to the atmosphere and ocean. In addition to CO₂ emissions and removals due to changes in land use, notably emissions from the clearing of forest land to make way for agriculture or settlements, CH₄ and N₂O emissions are produced by agricultural sources such as ruminant livestock, manure, rice cultivation, agricultural soils and the burning of agricultural residues.

Parties to the UN Framework Convention on Climate Change (UNFCCC) are currently negotiating a new 2015 climate change agreement under the Ad hoc Working Group on the Durban Platform for Enhanced Action (ADP). Many developed and developing countries may choose to include mitigation (and possibly also adaptation) actions in the land sector as nationally determined contributions under the 2015 agreement. The negotiation of the 2015 agreement presents an opportunity to create “an integrated accounting and incentive framework for adaptation and mitigation strategies across all land uses” (Parker et al., 2014). Such a reporting and accounting framework could improve comparability between the information provided by countries regarding emissions and removals from the land sector, while retaining flexibility to take into account national circumstances.

This paper focuses on land sector reporting and accounting³ in the context of the UNFCCC and has two aims. The first aim is to lay out possible elements of a long-term vision for the post-2020 reporting and accounting framework for emissions and removals from the land sector, building on existing experience with reporting and accounting as well as previous studies. The second aim is to identify possible steps that could be taken at COP 20 in 2014, COP 21 in 2015, and in 2016-2020 to put Parties on a pathway towards realising this vision.

The Intergovernmental Panel on Climate Change (IPCC) estimates that global anthropogenic GHG emissions from agriculture, forestry and other land use (AFOLU) currently total around 10-12 GtCO₂-eq per year, making it the second largest source of anthropogenic GHG emissions after the energy sector (IPCC, 2014a). Further, non-CO₂ emissions from agriculture are rising rapidly and since the mid-2000s they have been a greater GHG contributor than CO₂ emissions from deforestation (Christ, 2014). In this paper, the term “land sector” is used as shorthand to refer to the AFOLU sector.

There are currently several sets of arrangements for reporting and accounting for land sector emissions and removals. The IPCC has developed GHG inventory methods that treat the land sector coherently and are used for reporting to the UNFCCC. Under the Kyoto Protocol (KP), Annex B Parties⁴ account for agriculture and land use, land-use change and forestry (LULUCF) activities, although accounting remains voluntary for some LULUCF activities. A work stream on reducing emissions from deforestation and forest degradation and associated activities (REDD+) in developing countries has been established under

³ The IPCC defines accounting as “the rules for comparing emissions and removals as reported with commitments” (IPCC, 2000).

⁴ Annex B Parties are Annex I Parties with commitments under the Kyoto Protocol.

the UNFCCC. However, developing countries have not so far had international emissions limitation or reduction commitments under the UNFCCC or Kyoto Protocol and therefore anthropogenic emissions and removals from agriculture, forestry and other land use in developing countries remain largely unaccounted for. Further, accurate measurement of emissions and removals from the land sector can be difficult and some of the emissions are the result of essential activities such as food production – a particularly sensitive policy area in many developing countries.

Section 2 provides background information on recent relevant studies, existing arrangements for land sector reporting and accounting and special features of the land sector. Section 3 outlines possible elements of a long-term vision for land sector reporting and accounting that builds on existing approaches. Section 4 lays out possible short-term steps that could be taken over the coming years in the UNFCCC negotiations to lay the foundations for the long-term vision. Section 5 concludes. A discussion of the finance, technology and capacity building tools needed to support land sector mitigation and adaptation in developing countries is important but beyond the scope of this paper.

2. Background

2.1 Recent studies on post-2020 land sector accounting

Several studies examining post-2020 land sector accounting have recently been published. A selection of these are summarised in Table 1. The possible elements of a long-term vision outlined in this paper build upon common aspects of these studies where possible.

Table 1. Recent work on land sector accounting in the future climate agreement (not exhaustive)

Author/Year	Title	Main points
Canaveira (2013)	<i>Options and Elements for an Accounting Framework for the Land Sector in the Post-2020 Climate Regime</i>	This paper lays out various options for a future accounting framework with a strong focus on lessons learned from existing experience and new emerging accounting systems. The paper calls for a holistic approach to AFOLU accounting, with fungibility between AFOLU and other sectors, full carbon accounting on all lands, and a focus on creating incentives to promote good land management practices.
Estrada et al. (2014)	<i>Land Use in a Future Climate Agreement</i>	This paper presents the special features of the land sector, such as the legacy effect, non-permanence, natural disturbances and measurement uncertainties, and discusses how those features could be addressed in the 2015 agreement. It lays out different options for the form of land sector contributions as well as options for incentives, both monetary and non-monetary, to increase the ambition of land sector contributions.
Hood, Briner and Rocha (2014)	<i>GHG or not GHG: Accounting for Diverse Mitigation Contributions in the Post-2020 Climate Framework</i>	This paper contains a chapter describing possible options for a more comprehensive land sector accounting system, including a KP activity-based approach, a UNFCCC land-based approach, a “reference levels for all” approach, and “agreement on principles” for land sector accounting. It also explores how the concept of bounded flexibility could be applied to the land sector and identifies elements needed for the construction of reference levels.
Iversen et al. (2014)	<i>Understanding Land Use in the UNFCCC</i>	This paper presents a comprehensive overview of existing arrangements for the land sector, including reporting and accounting under the Convention and the KP, REDD+, CDM and Joint Implementation (JI) accounting, as well as treatment of natural disturbances, harvested wood products, and social and environmental safeguards.
Parker et al. (2014)	<i>The Land-Use Sector within the Post-2020 Climate Regime</i>	This paper examines four options for post-2020 land sector contributions: national economy-wide targets; national or sub-national sectoral baselines; project-level sectoral baselines; and policies and measures. It calls for an integrated approach to mitigation and adaptation strategies in the land sector, as well as the convergence of LULUCF, REDD+ and agriculture accounting to create a set of harmonised, coherent policies on land use.

2.2 Existing arrangements for land sector reporting and accounting

There are currently several systems for land sector reporting and accounting. These include: reporting for anthropogenic GHG emissions and removals under the Convention; reporting and accounting for LULUCF activities for Annex B Parties under the Kyoto Protocol; measurement, reporting and verification for afforestation, reforestation and agriculture projects in developing countries via the Clean Development Mechanism (CDM) as well as voluntary carbon markets; recognition for REDD+ activities in developing countries; and arrangements for emission reduction targets for developed countries and nationally appropriate mitigation actions (NAMAs) for developing countries under the Cancun Agreements.

The unique features of the land sector, such as natural disturbances and the risk of crediting or debiting non-anthropogenic outcomes, make it difficult to design a simple accounting system for this sector. For example, most but not all LULUCF activities can be accounted for by Annex B Parties under the Kyoto Protocol – some activities are mandatory, some are voluntary, some accounting rules depend on decisions taken in the previous commitment period, and different types of baseline are used for different activities. There are currently separate sets of arrangements for Annex B Parties and other Parties and there is no international accounting framework that is applicable to all Parties. This makes it difficult to estimate the aggregate impact of mitigation actions being undertaken in the land sector in different countries. Further, the existing accounting arrangements provide selected coverage of emissions and removals from the land sector (Table 2). The existing accounting arrangements therefore do not necessarily provide recognition for the full range of mitigation opportunities available in the land sector.

The existing arrangements for reporting and accounting in the land sector are outlined below. Convergence of the existing separate arrangements could eventually result in an accounting framework for the land sector that is applicable to all Parties and provides recognition for a diverse range of actions to tackle climate change in the land sector.

Table 2. The scope of existing land sector reporting and accounting arrangements

Land-use change/activity	GHG inventories	KP CP1	KP CP2	CDMh	REDD+
Afforestation ^a	Included	Mandatory	Mandatory	Yes	Voluntary ⁱ
Reforestation ^b	Included			Yes	Voluntary ⁱ
Deforestation ^c	Included			N/A	Voluntary ^j
Forest management	Included	Voluntary ^e	Voluntary ^g	N/A	Voluntary ^k
Cropland management	Included			N/A	N/A
Grazing land management	Included			N/A	
Revegetation	Included			N/A	
Wetlands/wetland drainage and rewetting ^d	Included	N/A ^f	Voluntary	N/A	N/A
Enteric fermentation	Included	Mandatory	Mandatory	Yes	
Manure management	Included			Yes	
Soil management	Included			Yes	
Biomass burning	Included			Yes	
Rice cultivation	Included			Yes	
Liming and urea use	Included			N/A	

^a Afforestation is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or human-induced promotion of natural seed sources (UNFCCC, 2005).

^b Reforestation is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forest land (UNFCCC, 2005).

^c Deforestation is the direct-human induced conversion of forested land to non-forested land (UNFCCC, 2005).

^d The coverage of wetlands in GHG inventories and in KP accounting is different. Wetlands in GHG inventories include natural and manmade lakes, rivers, reservoirs and peat extracting areas. Under the KP, wetlands drainage and rewetting can include drained areas used for agriculture if cropland management is not accounted as well as areas with peat extraction where a direct human-induced regulation of the water level is carried out.

^e Cap applied for forest management which is not relative to a base year. Other voluntary activities are relative to a base year, and uncapped.

^f Though covered in part by other activities such as grassland management.

^g But mandatory if elected in CP1.

^h "Yes" is displayed in this column if at least one CDM methodology exists for the activity concerned.

ⁱ Afforestation and reforestation here refer to the REDD+ activity "enhancement of carbon stocks".

^j Deforestation here refers to the REDD+ activities "reducing emissions from deforestation".

^k Forest management here refers to the REDD+ activities "reducing emissions from forest degradation, the role of conservation, sustainable management of forests and enhancement of forest carbon stocks".

Source: Based on Iversen et al., 2014; Canaveira, 2013

Reporting emissions and removals from agriculture, forestry and other land use

Table 3 summarises existing reporting requirements for developed and developing countries for information relating to the land sector. Annex I Parties currently provide annual inventories of anthropogenic GHG emissions and removals from agriculture and all managed lands. These include common reporting format (CRF) tables containing quantitative information on emissions and removals, as well as national inventory reports (NIRs) containing qualitative information on emissions trends and data collection methods and systems. Annex B Parties (a sub-set of Annex I Parties) are required to provide supplementary information relating to their commitments in national communications, CRF tables (for information on GHG emissions and removals) and standard electronic format (SEF) tables (for information on GHG units).

There are separate reporting requirements for non-Annex I Parties under the Convention. Non-Annex I Parties are to report GHG inventories as part of biennial update reports and national communications, which are to be provided every four years subject to availability of support. Non-Annex I Parties shall, to the extent possible, estimate anthropogenic emissions and removals of CO₂, CH₄ and N₂O in their GHG inventories, and are encouraged to report information on emissions of HFCs, PF₆ and other GHGs as

appropriate (UNFCCC, 2002). For non-Annex I countries pursuing REDD+ activities⁵ there are additional reporting requirements, including information on proposed forest reference emissions levels and how safeguards are being addressed and respected.

GHG inventories of anthropogenic emissions and removals from energy, transport, industry, waste and AFOLU are reported by Parties in accordance with IPCC guidelines. The aim of the IPCC guidelines is to ensure that GHG inventories are “neither over nor under-estimates as far as can be judged” (IPCC, 2000). Further, uncertainties in the data are to be reduced as far as practicable. The use of these guidelines enhances comparability and can help to provide robust and comparable data on emissions and removals that can in turn provide a basis for accounting. The IPCC guidelines are developed over time with updated guidelines and supplements. Table 4 summarises the IPCC guidance available to date specifically for the land-related parts of GHG inventories. There are currently differences in the IPCC guidance recommended for use by Annex I and non-Annex I Parties. Consistency between GHG inventories would be improved if all Parties were use the IPCC 2006 Guidelines to prepare their inventories while using different IPCC tiers⁶ for keys categories according to national capacities.

The IPCC guidelines for GHG inventories divide all land into six land categories. These categories are forest land, cropland, grassland, settlements, wetlands and other land. A distinction is also made between managed and unmanaged land, where managed land is defined as “land where human interventions and practices have been applied to perform production, ecological or social functions” (IPCC, 2006). Conversions of managed land from one category to another are tracked. To compile the GHG inventory, emissions and removals resulting from each land-use category are estimated, as well as emissions and removals resulting from land-use changes. This approach is known as the “land-based” approach.

⁵ Many non-Annex I countries are undertaking REDD+ activities with non-UNFCCC programmes that support those activities, such as the UN-REDD Programme, the REDD+ Partnership, the Forest Investment Program (FIP) and the Forest Carbon Partnership Facility (FCPF).

⁶ The IPCC tier approach represents a hierarchy of levels of methodological complexity (IPCC, 2006). Higher tiers imply increased accuracy in the method or parameters used in the estimation of emissions and removals. Tier 1 refers to the use of default data whereas Tier 2 implies the use of country-specific data. Advanced methods and detailed country-specific data are applied within the Tier 3 approach. Higher tiers are generally considered to be more accurate but can also imply higher uncertainties. If capacity is available, higher tier methodologies shall be especially applied for key sources due to their implication for the absolute emission level (IPCC, 2000).

Table 3. Summary of existing reporting requirements

Reporting channel	Frequency	Relevant content
GHG inventories	<p>Annex I Parties: Annual (NIRs, CRF tables) and included in biennial reports and national communications</p> <p>Non-Annex I Parties: Included in biennial update reports and national communications</p>	<p>Annex I Parties: Anthropogenic GHG emissions and removals from land sector, comprising forestry and other land use (mainly CO₂ emissions and removals associated with carbon stock changes) and agriculture (mainly non-CO₂ emissions associated with fertilizer application, enteric fermentation, manure management, biomass burning and rice cultivation). CRF tables divide AFOLU into Agriculture and LULUCF components.</p> <p>Annex B Parties: Supplementary information to demonstrate compliance with KP commitments provided in NIRs, CRF tables and SEF tables</p> <p>Non-Annex I Parties: See Annex 1 Parties</p>
National communications	<p>Annex I Parties: Every four years</p> <p>Non-Annex I Parties: Every four years (subject to availability of support, with additional flexibility for LDCs and SIDSs)</p>	<p>Annex I Parties: National circumstances; GHG inventory information; policies and measures; emissions projections; vulnerability and adaptation; support provided; research and observation; education, training and public awareness</p> <p>Annex B Parties: Supplementary information to demonstrate compliance with KP commitments</p> <p>Non-Annex I Parties: National circumstances; GHG inventory; mitigation and adaptation measures; support needed, research and observation; education, training and public awareness; information on how REDD+ safeguards are being addressed and respected (if applicable)</p>
Biennial reports / biennial update reports	<p>Annex I Parties: Every two years</p> <p>Non-Annex I Parties: Every two years (subject to availability of support, with additional flexibility for LDCs and SIDSs)</p>	<p>Annex I Parties: Progress in the achievement of emission reduction targets, information on mitigation actions and their effects as well as estimates of emission reductions and removals and the use of units from the market-based mechanisms and land use, land-use change and forestry activities, emissions projections to 2030, support provided</p> <p>Non-Annex I Parties: GHG inventory, information on mitigation actions, domestic MRV, support received/needed</p>
REDD web platform and information hub	<p>Non-Annex I Parties: Information can be provided on a voluntary basis</p>	<p>Non-Annex I Parties: National strategy or action plan, submissions of proposed forest reference emission levels and/or forest reference levels, information on how REDD+ safeguards are being addressed and respected (if applicable), information on MRV provided in technical annex in BUR, information on drivers of deforestation and forest degradation and means to address them</p>

Table 4. Summary of the IPCC guidelines for GHG inventory reporting

Name of guidelines	Content/scope	Use of guidelines
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories	<p>Agriculture:</p> <ul style="list-style-type: none"> ● Enteric fermentation ● Manure management ● Rice cultivation ● Agricultural soils ● Prescribed burning of savannahs ● Field burning of agricultural residues <p>Land-use change and forestry:</p> <ul style="list-style-type: none"> ● Changes in forest and other woody biomass stocks ● Forest and grassland conversion ● Abandonment of managed lands ● CO₂ emissions and removals from soil 	<p>Annex I: “Shall” until 2012 (2014 submission) (Decision 2/CP.3) Non-Annex I: “Should” (Decision 2/CP.3)</p>
2000 Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories	Assists countries in producing inventories that are neither over nor underestimates so far as can be judged, and in which uncertainties are reduced as far as practicable. Works with the 1996 Guidelines and covers agriculture but not forestry and other land use.	<p>Annex I: “Shall” until 2012 (2014 submission) (Decision 18/CP.8) Non-Annex I: “Should” (Decision 2/CMP.7)</p>
2003 Good Practice Guidance for Land use, Land-use Change and Forestry (includes a chapter on “Supplementary Methods and Good Practice Guidance arising from the Kyoto Protocol”)	Extends the concept of good practice guidance to forestry and other land use. Also provides supplementary methods and good practice guidance for estimating, measuring, monitoring and reporting on carbon stock changes and greenhouse gas emissions from LULUCF activities under Article 3, paragraphs 3 and 4, and Articles 6 and 12 of the Kyoto Protocol. Establishes the six land use categories used for 2006 guidelines.	<p>Annex I: “Shall” until 2012 (2014 submission) (Decisions 17/CMP.1 and 13/CP.9) Non-Annex I: “Should” (Decision 2/CMP.7)</p>
2006 IPCC Guidelines for National Greenhouse Gas Inventories	<p>Consolidates the two sets of GPG and updates the guidelines to include new sources and gases as well as updates to the previously published methods (e.g. default emissions and stock change factors).</p> <p>Agriculture:</p> <ul style="list-style-type: none"> ● Enteric fermentation ● Manure management ● Rice cultivation ● Liming and urea application (new) ● N₂O from managed soils (new) ● Emissions from biomass burning (new) <p>Forestry and other land use:</p> <ul style="list-style-type: none"> ● Forest land ● Cropland ● Grassland ● Wetlands ● Settlements ● Other land <p>Harvested wood products (new)</p>	<p>Annex I: “Shall” after 2013 (2015 submission) (Decisions 6/CMP.9 and 24/CP.19) Non-Annex I: No decision (although some non-Annex I Parties are already using them)</p>
2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands	Extends the content of the 2006 IPCC Guidelines by filling gaps in coverage and providing updated information reflecting scientific advances, including updating emission factors. It covers inland organic soils and wetlands on mineral soils, coastal wetlands including mangrove forests, tidal marshes and sea grass meadows and constructed wetlands for wastewater treatment.	<p>Annex B: “Shall” from 2013 (2015 submission) for wetland drainage and rewetting in CP2, “encouraged” for other activities (Decision 6/CMP.9) Non-KP Annex I: “Encouraged” after 2015 (Decision 24/CP.19) Non-Annex I: No decision</p>
2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol	Provides supplementary methods and good practice guidance for estimating anthropogenic greenhouse gas emissions by sources and removals by sinks resulting from LULUCF activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol for the second commitment period.	<p>Annex B: “Shall” from 2013 (2015 submission) (Decision 6/CMP.9) Non-KP Annex I: N/A Non-Annex I: N/A</p>

^a Shows if COP decisions stipulate whether Parties “shall”, “should” or are “encouraged” to use the guidelines.
Source: Based on IPCC, 1996; IPCC, 2000; IPCC, 2003; IPCC, 2006; IPCC, 2014b; IPCC, 2014c

LULUCF accounting under the Kyoto Protocol

A set of principles for LULUCF accounting were agreed at CMP 1 in 2005. These were (UNFCCC, 2005):

- a) That the treatment of these activities be based on sound science.
- b) That consistent methodologies be used over time for the estimation and reporting of these activities.
- c) That the aim stated in Article 3, paragraph 1, of the Kyoto Protocol not be changed by accounting for land use, land-use change and forestry activities.
- d) That the mere presence of carbon stocks be excluded from accounting.
- e) That the implementation of LULUCF activities contributes to the conservation of biodiversity and sustainable use of natural resources.
- f) That accounting for LULUCF does not imply a transfer of commitments to a future commitment period.
- g) That reversal of any removal due to LULUCF activities be accounted for at the appropriate point in time.
- h) That accounting excludes removals resulting from: (i) elevated carbon dioxide concentrations above their pre-industrial level; (ii) indirect nitrogen deposition; and (iii) the dynamic effects of age structure resulting from activities and practices before the reference year.

Accounting for emissions and removals in the land sector in the context of Annex B Party commitments under the Kyoto Protocol is not only based on national GHG inventories. Rather, a set of anthropogenic LULUCF activities was identified with an impact on GHG emissions or removals. This approach is known as the “activity-based” approach. An activity-based approach to LULUCF accounting was chosen partly in order to limit the risk of non-anthropogenic emissions and removals being counted towards the mitigation commitments of Annex B Parties and to deal with the difficulties associated with legacy effects in the forestry sector. Accounting is mandatory for some LULUCF activities and voluntary for others (as shown in Table 2).

The accounting framework of the Kyoto Protocol has a robust reporting and review system. Colour-coded common reporting format (CRF) tables are used for reporting which enhances clarity. Technical expert reviews of GHG inventories, national communications and biennial reports of Annex I countries (as well as a compliance process) provide confidence in the information reported.

The accounting system of the Kyoto Protocol has evolved between the first and second commitment period. A major change was the introduction of Forest Management Reference Levels (FMRLs) to account for forestry management in a way that could deal with legacy effects. In addition, forest management became a mandatory activity and the scope of accounting was expanded to include wetland drainage and rewetting. Further changes were made through other technical rules, such as provisions for treating natural disturbances and harvested wood products (for further details see Canaveira, 2013, and Iversen et al., 2014).

Forest management reference levels were introduced for forest management activities in the second commitment period in order to help Parties avoid the random effects that age-class distribution can have on emissions and removals from forest management. FMRLs are baselines against which progress in implementation of forest management activities is measured. Parties were given some flexibility in the methodological approaches used to construct FMRLs. These FMRL were also reviewed by technical experts in order to enhance their credibility. The significant impact of the technical review process was

reflected by the fact that at least 23 Parties out of 38 revised their FMRLS following the review (UNFCCC, 2011a). Despite some inconsistencies, the technical review concluded that the information provided by Parties about the construction of the FRMLS was “sufficiently transparent and thus fulfils most of the required criteria” (ibid.).

One of the challenges associated with LULUCF accounting under the Kyoto Protocol for the first commitment period was that the LULUCF accounting provisions were negotiated after national commitments to limit or reduce emissions had already been agreed. This provided an incentive for Parties to negotiate accounting rules that would make it easier to meet their already-fixed emissions commitments. Ideally, the POST-2020 accounting framework would be agreed before future commitments are finalised, so that commitments are influenced by the accounting framework. Given the short time remaining, however, it is unlikely that all of the details of the accounting framework will be agreed before intended nationally determined contributions are put forward under the ADP. Therefore Section 4 of this paper explores what could be agreed by 2015, and what could be worked on in 2016-2020.

REDD for developing countries

REDD+ provides recognition for enhanced action to combat deforestation and forest degradation as well as conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks in developing countries (UNFCCC, 2010). Reducing or preventing deforestation has been identified by the IPCC as the mitigation option with the most immediate and greatest effect on carbon stocks in the short term, and is highly cost-effective (IPCC, 2014a). However, strong measurement, reporting and verification (MRV) provisions are needed to ensure that emission reductions from REDD+ are real. As part of the “Warsaw Framework for REDD-plus”, specific modalities for MRV were agreed upon (UNFCCC, 2013e).

Reference levels for forestry are used to measure progress on REDD+. In 2011, the COP invited REDD+ countries to communicate their forest reference emissions levels and/or forest reference levels to the UNFCCC Secretariat. The COP subsequently agreed in 2013 that each submission is to undergo a technical assessment, to assess the degree to which the information provided is in accordance with the reporting guidelines and to offer a “facilitative, non-intrusive, technical exchange of information” on the reference levels (UNFCCC, 2013a). The first forest reference level was submitted by Brazil in June 2014 (Government of Brazil, 2014).

REDD+ reporting provisions include social and environmental safeguards. A list of safeguards was established at COP 16 and REDD+ Parties are to submit reports on how these safeguards are being addressed and respected (UNFCCC, 2011b). Examples of safeguards include conservation of natural forests and biological diversity as well as respect for the knowledge and rights of indigenous peoples and members of local communities. While the extent to which the current provisions for safeguards will have an impact on the ground is yet to be seen, this could be an important step towards protecting the rights of local communities and moving towards more open and inclusive forms of decision-making on important land-related issues.

Reduced Emissions from All Land Uses (REALU) in developing countries

Expanding the scope of land sector reporting and accounting in developing countries over time could help Parties to receive recognition for a greater range of the mitigation opportunities that exist in the sector, and lead to more joined up policy-making. In particular, the agriculture sector needs to be covered by the accounting framework in a way that does not compromise, or if possible enhances, food production. To this end, the World Agroforestry Centre (ICRAF) has developed a methodology for “Reduced Emissions from All Land Uses” (REALU) in developing countries, and is currently exploring the feasibility of this

landscape approach in Cameroon, Indonesia, Peru and Vietnam. The REALU approach addresses the partial accounting of REDD+ and the emission reduction potential in other land uses such as trees outside forests. It is based on baselines and Reference Emission Levels (RELs) and aims at credit generation. While development of the REALU methodology is taking place outside of the UNFCCC process, proponents describe REALU as a possible stepping stone between REDD+ and broad land sector accounting in the post-2020 period (see e.g. Bernard et al., 2013).

Project-level methodologies

There are currently two types of forestry sector projects (afforestation and reforestation activities) that can be eligible to receive credits under the CDM. The credits generated by these projects can be purchased by Annex B Parties and used to meet part of their commitments. The issue of non-permanence is dealt with by the issuance of temporary Certified Emission Reduction units (tCERs or ICERs) to afforestation and reforestation projects under the CDM. To date the number of such projects has been low (55 as of July 2014, representing around 2 Mt CO₂-eq) and concentrated in a small number of countries (mainly Colombia, India, Brazil, Moldova and China) (UNFCCC, 2014a).

CDM methodologies also exist for some agriculture-related projects addressing non-CO₂ gases. These include manure management, methane avoidance/recovery, offsetting of nitrogen fertiliser use, use of agriculture residues for energy production and reduced emissions from rice cultivation. There is also experience in the voluntary carbon markets sector regarding project-level methodologies in the land sector. The bottom-up nature of voluntary markets means that different mechanisms have different methodologies and geographic scopes.

NAMAs under the Cancun Agreements

Many developing countries have put forward nationally appropriate mitigation actions (NAMAs) in the land sector for 2020 (and/or other years). The future land sector reporting and accounting system could learn lessons from REDD+ and the process for NAMAs (Canaveira, 2013). While progress in implementation of REDD+ activities is to be conducted via country-specific reference levels, many countries have also chosen to express NAMAs as goals relative to “business as usual” baselines in 2020. It is possible that these two approaches could be merged, with NAMAs providing “broad economy-wide low-emission development strategies” and REDD+ activities forming part of this strategy (GIZ, 2013).

While REDD+ applies only to forestry-related activities, NAMAs can encompass almost any mitigation activity and form, from economy-wide or sectoral emissions reduction goals and policies and measures to individual projects and programmes. REDD+ activities themselves could be considered NAMAs. Land sector NAMAs targeting the whole AFOLU sector could be significantly wider in scope than REDD+ activities. Similar to the safeguards under REDD+, Parties could be invited to provide information about other benefits of mitigation activities under the NAMA approach.

Aligning the approaches for the establishment of baselines for NAMAs and REDD+ could facilitate result-based payments (GIZ, 2013). REDD+ and NAMAs both require a transparent MRV framework that could be streamlined via the establishment of a national MRV framework including both approaches. COP 19 further decided that the MRV for REDD+ should be coherent with guidance for the MRV for NAMAs (UNFCCC, 2014b).

Agriculture

For Annex B Parties, anthropogenic GHG emissions from agriculture are covered by the reporting and accounting framework of the Kyoto Protocol. Annex B Parties are to ensure that their emissions of the gases listed in Annex A of the Kyoto Protocol do not exceed their assigned amounts. This annex includes,

among other gases, CH₄, N₂O and CO₂ from enteric fermentation, manure management, rice cultivation, agricultural soils, prescribed burning of savannahs, and field burning of agricultural residues. Agriculture is treated in the same way as other inventory categories under the KP. Further, there are a small number of CDM methodologies available to quantify emission reductions from manure management, methane recovery, offsetting nitrogen fertiliser use and rice cultivation projects in developing countries.

Most developed countries have clarified that agriculture will be included in their emissions reduction targets for 2020 under the Cancun Agreements (UNFCCC, 2013b). Many non-Annex I Parties or groups of Parties have communicated mitigation actions relating to agriculture under the Cancun Agreements (e.g. the African Group, Chad, Colombia, Côte d'Ivoire, Dominica, Eritrea, Ethiopia, Ghana, Guinea, Indonesia, Jordan, Madagascar, Malawi, Morocco, Swaziland, Tunisia) (UNFCCC, 2013c). However, in most cases the precise scope of the actions and how they will be accounted for remains unclear.

An approach is needed for the post-2020 period that promotes mitigation action while taking into account competing policy priorities such as food production. One possible solution would be for Parties to choose to put forward mitigation actions in the agriculture sector using reference levels or intensity or productivity metrics, such as GHG emissions per unit of agricultural output. Such approaches would take into account the fact that absolute increases in GHG emissions from the agriculture sector are expected for some countries in the short term, but Parties could still receive recognition under the 2015 agreement for taking action to increase efficiency in this sector and decouple GHG emissions from output.

2.3 Special characteristics of the LULUCF part of the land sector

The LULUCF part of the land sector has a number of special features that distinguish it from emissions from agriculture, energy, transport, industry and waste (Estrada et al., 2014). These features include difficulty in separating anthropogenic from natural emissions and removals, strong legacy effects due to structural features of forests, and potential reversals of GHG removals due to natural disturbances or human activities. There tend to be high uncertainties in estimates of emissions and removals from agriculture and LULUCF. Further, often there are also competing goods and services for the same land, such as agricultural production and biodiversity conservation.

Identifying anthropogenic emissions and removals

The UNFCCC is focused on anthropogenic GHG emissions and removals. However, for LULUCF it can be especially difficult to separate anthropogenic and non-anthropogenic emissions and removals. This is because the flows of emissions and removals through ecological systems are complex and it is difficult to identify causality. For example, a wild fire can be indirectly affected by human activities such as former harvesting activities or fire suppression, while a fire started by humans can be substantially influenced by natural causes such as prior drought (IPCC, 2009).

The IPCC approach used to separate anthropogenic emissions and removals in GHG inventories is known as the “managed land proxy”. The managed land proxy works by dividing the total land area into managed and unmanaged land. Emissions and removals occurring on managed land are assumed to be anthropogenic, while emissions and removals occurring on unmanaged land are assumed to be naturally occurring. The IPCC definition of managed land is “land where human interventions and practices have been applied to perform production, ecological or social functions” (IPCC, 2009).

This proxy is used since for LULUCF activities there is currently no practicable methodology available to factor out direct anthropogenic effects from indirect anthropogenic and natural effects. Estimates of GHG emissions and removals on managed lands are therefore used as a proxy for anthropogenic emissions and removals.

Legacy effects

Patterns of harvesting and replanting can have significant impacts on forest-related anthropogenic GHG emissions and removals over a given period. These impacts are known as legacy effects, since the impacts can stem from past management decisions which affect the age-class structure of forests. Harvest activities influence the carbon stock of forest ecosystems especially via the subsequent regrowth and higher sequestration rates. Those effects can last for decades and can be greater than forest management activities during a given period (Böttcher, Kurz and Freibauer, 2008). As a consequence, Parties implementing the same management activities can have very different results depending on the age structure of their forest ecosystems. Countries with a high percentage of forests can substantially benefit (or lose out) from past harvesting activities. Legacy effects are most significant for forests, due to the long production cycles involved, but can also be observed to a lesser extent in other systems such as croplands.

The treatment of legacy effects was part of the development of the accounting rules from the first to the second commitment period under the Kyoto Protocol. For the second commitment period, forest management is mandatory and Parties are able to incorporate legacy effects in the construction of projected FMRLs. A significant advantage of projected reference levels is the avoidance of a so-called “base year lottery” that creates advantages or disadvantages due to the emission level in the base year (Canaveira, 2013).

Previous CCXG work has highlighted that many different methods exist for developing baselines and information on underlying assumptions is the key to understanding baselines (Clapp and Prag, 2012). While various approaches to developing FMRLs can provide flexibility for Parties and therefore incorporate a range of national circumstances, this variety also reduce the comparability of approaches used (EDF, 2012). The approaches used by Parties for setting FMRLs in the second KP commitment period were (UNFCCC, 2011a):

- a) Projections using country-specific methodologies (17 Parties)
- b) Projections using a common approach developed by the European Commission Joint Research Centre (14 Parties)
- c) Historical FMRL based on a single year (3 Parties)
- d) Average emissions and removals during a historical time series (1 Party)
- e) Linear extrapolation of a historical trend (2 Parties)
- f) Setting the baseline to zero, known as “gross-net accounting” (1 Party)

Natural disturbances and reversals of CO₂ removals

The removal of CO₂ from the atmosphere by land sinks via photosynthesis is not necessarily a permanent process. There are several means by which this process can be reversed and the stored carbon can be released back into the atmosphere. These include the occurrence of natural disturbances, such as natural fires or the outbreak of pests or a disease, or human activities, such as subsequent harvesting or land-use change. Carbon stocks in the land sector are therefore said to have a high risk of “non-permanence”. Examples of natural disturbances that have resulted in substantive GHG emissions from the land sector include forest fires in Australia and bark beetle infestations in Canada.⁷

⁷ The infestation of forests with bark beetles can lead to a high mortality of large areas of forests that causes significant emissions. A pine beetle infestation in 2008 in Canada produced the same amount of carbon emissions as a five year period of Canada’s transport sector (Bateman, 2012).

The frequency (and in some cases the severity) of natural disturbances for forests and soils is likely to increase due to climate change (Seidl et al., 2014). For example, an outbreak of mountain pine beetle has devastated 11 million hectares of forest in Canada and the US since the late 1990s. This significant disturbance has been exacerbated by higher average winter temperatures, which are highly likely to be a consequence of anthropogenic climate change (FAO, 2010).

The possibility of sequestration reversals by natural disturbances beyond the control of the Party concerned can represent a significant risk to the achievement of mitigation targets or actions. Therefore special provisions may be agreed to manage this risk. In the first commitment period of the Kyoto Protocol there was no natural disturbances provision, other than the use of the managed land proxy. The issue of non-permanence was dealt with in the second commitment period of the Kyoto Protocol with the inclusion of a so-called “natural disturbance provision”. The natural disturbance provision allows Parties to exclude emissions from accounting resulting from events that are not “materially influenced” by the Party and thereby guarantees that Parties are not penalised for nature-induced emissions (UNFCCC, 2011c). The removals following the disturbance are also excluded.

To be eligible to use the natural disturbances provision, a Party must include information in its 2015 national inventory report on the background level of emissions from natural disturbances included in its FMRL. In order to be excluded from accounting, emissions from a natural disturbance must exceed a background level (plus a margin, if applicable), and no land-use change can take place after the natural disturbance. Reporting requirements help to ensure that this provision is not “gamed”. The natural disturbances provision only applies to afforestation, reforestation and forest management activities. A disadvantage of the natural disturbances provision is that emissions from substantial land areas may not be accounted for (Funk, 2014).

It is possible that the natural disturbances provision could be expanded to other activities and lands such as cropland and grassland, as well as draught (Canaveira, 2013). There could also be a single natural disturbance provision for all IPCC forest categories, rather than separate provisions for separate lands and activities (Estrada et al., 2014). An expansion of that provision would require further guidance on emissions resulting from natural disturbances, since the only guidance to date on forest-related emissions under the Kyoto Protocol is in the IPCC 2013 KP Supplement. This guidance only applies to Annex B Parties and there is currently no guidance for non-KP Parties or developing countries (Iversen et al., 2014). An exclusion of the natural disturbances provision within the new climate agreement might lead reduced ambition by Parties with high risk of natural disturbance (Estrada et al. 2014). According to Funk (2014), the voluntary option for excluding natural disturbances could be maintained under the condition of adopting “robust criteria and strong review”.

Non-permanence is also an issue if credits for stored carbon have been issued via a project-based mechanism such as the Clean Development Mechanism (CDM) and used to offset emissions elsewhere. In order to deal with the potential reversibility of land-carbon stocks, afforestation and reforestation projects under the CDM are issued special credits known as temporary certified emissions reductions (tCERs) or long-term CERs (lCERs). Temporary CERs expire at the end of the commitment period in which they are issued, and have to be replaced. Long-term CERs expire at the end of a crediting period (which can be up to 30 years, or 20+20+20 years), with verification every five years that reversals have not occurred.

The additional risk of having credits that may need to be replaced in future leads to a lower market price for credits from afforestation and reforestation projects compared to conventional CDM projects. There are ongoing discussions in the UNFCCC regarding alternative approaches to deal with the risk of non-permanence in the context of the CDM. The issue of non-permanence has yet to be addressed in the context of REDD+. While LULUCF accounting encompasses both credits and debits, under REDD+ only reductions in emissions have so far been recognised, although further rules could emerge in future.

High uncertainty and inter-annual variability

There is some uncertainty associated with estimates of anthropogenic GHG emissions and removals in any sector. Due to the complex nature of the land sector, however, which comprises a diffuse set of linked ecosystems on land and in the soil, emissions and removals from this sector are particularly difficult to estimate accurately. This is not simply a reflection of different levels of national capacity for measuring and reporting – there can be significant uncertainty associated with data (both in terms of activity data and emission factors) for developed countries with high capacity, as well as for developing countries with low capacity. Further, annual fluctuations in anthropogenic GHG emissions and removals from LULUCF can be significantly greater than those for other sectors. In some cases, for example, LULUCF can go from being a net sink one year to a net source the next.

Annex I countries perform an uncertainty calculation as part of their annual national inventory reports. Information is provided on the activity data uncertainty, the emission or removal factor uncertainty, and the combined uncertainty for each emissions source or sink in the inventory as well as the overall uncertainty in the national total and in the national trend. In the case of New Zealand's 2014 GHG inventory, containing data for the year 2012, the combined uncertainty associated with CO₂ emissions from liquid fuels was 3%. By contrast, the combined uncertainty was 16% for CH₄ emissions from enteric fermentation, 30% for CH₄ emissions from manure management, 54% for CO₂ emissions from forest land, 74% for N₂O emissions from agricultural soils, and up to 100% for N₂O emissions from manure management (New Zealand Government, 2014a).

The extent to which this uncertainty translates to uncertainty in total anthropogenic GHG emissions depends on the relative weights of each source or sink in a country's total emissions, and uncertainty is reduced because uncorrelated uncertainties do not add linearly. Furthermore the uncertainty on a trend is generally smaller than the absolute uncertainty in any year. Nevertheless, there is generally greater uncertainty associated with the GHG inventories of Parties for which AFOLU accounts for a high share of total anthropogenic GHG emissions, and lower uncertainty for Parties for which AFOLU accounts for only a low share of total emissions.

While the levels of uncertainty for estimates of emissions and removals from the land sector are relatively high, advances in remote sensing technology for tracking land-use change are helping to reduce them. In particular, the use of satellites is revolutionising this area. Some data are already freely-available from space agencies and the next generation of earth observation satellites will provide open access to advanced, high-resolution land-use mapping tools (Box 1).

Box 1: Recent developments in satellite remote sensing technology and tracking initiatives for land sector observations

As part of the Copernicus space programme being undertaken by the European Commission and the European Space Agency (ESA), the ESA is launching a new family of missions called Sentinels (ESA, 2014). Each mission consists of two satellites carrying a range of different technologies and imaging instruments for land, ocean and atmospheric monitoring. Sentinel-1 was launched in April 2014 and will provide free and open access data for the monitoring of forest, water, soil and agriculture lands. The twin satellites, orbiting 180° apart, will image the entire Earth once every six days, with a spatial resolution of up to 5x5 m. Sentinel-1 will enable accurate tracking of changes in land use over time, in particular detection of forest clearing and partial clearing, forest type classification, biomass estimation, disturbance detection and forest fire mapping, as well as monitoring of agricultural crop conditions, soil properties and tillage activities.

In January 2014, the Global Forest Observations Initiative (GFOI) published a Methods and Guidance Document (MGD) (GFOI, 2013). The MGD systematically sets out for the first time how the impact of REDD+ activities can be estimated using IPCC methodologies. The MGD was developed by UN-REDD, the World Bank Forest Carbon Partnership Facility (FCPF), the space agencies and other land sector experts. The space agencies have agreed to make freely available (via a specially established Space Data Coordination Group) remotely sensed data from a set of core missions identified in the MGD, including Landsat (which has the most extensive archive of historical data relevant to REDD+) and Sentinel.

Global Forest Watch (GFW), convened by the World Resource Institute, is an online monitoring tool and alert system providing timely data about global forest loss (WRI, 2014a). The tool was established in February 2014. Using satellite technology and cloud-computing power, GFW provides maps showing current forest management as well as protected areas with a 500 m resolution, including global forest change maps produced by the University of Maryland using Landsat data. A unique asset of GFW is its crowdsourcing function that allows users to upload and share data and build networks and coalitions within the GFW. In July 2014, a new program called Global Forest Watch Fires was launched in collaboration with the National REDD+ Agency of Indonesia (WRI, 2014b). It monitors and reacts to fires in South East Asia by using a SMS alert system.

Peru launched a high-resolution map of its land-carbon stocks in July 2014 – the first map of its kind on a national scale (Carnegie Institution for Science, 2014). The team constructing the map combined data from an integrated airborne laser mapping technology developed by the Carnegie Airborne Observatory with publicly available satellite maps of forest cover and other land uses. The result is a 3D map showing carbon density at up to a 1x1 m resolution. The total carbon stock was estimated to be around 6.9 billion tonnes, with the largest stocks located in the northern Peruvian Amazon and along the Brazil-Peru border.

3. Possible elements of a long-term vision for land sector reporting and accounting

This section lays out possible elements of a long-term vision for land sector reporting and accounting. The aim of this exercise is to outline possible elements for a long-term vision to work back from, as a means to generate discussion on the issue. Other ways forward are no doubt possible. The precise time frame of the vision is not specified. The full vision might not be attained by 2020. Parties could agree to a shared direction of travel along various dimensions of the accounting framework, such as agreement to increase the comprehensiveness of accounting over time.

3.1 Possible elements of a long-term vision

The long-term aim of post-2020 land sector reporting and accounting could be to create a multi-dimensional reporting and accounting framework that is applicable to all Parties and increases the comprehensiveness of reporting and accounting over time. The possible elements of a long-term vision for land sector reporting and accounting identified in this paper include generic elements (i.e. elements that are relevant to all sectors) and land-specific elements (i.e. elements that are relevant to the land sector only). The elements include:

Generic elements (relevant to all sectors)

- Use of IPCC 2006 Guidelines by all Parties (with flexibility for least developed countries and small island developing states) for reporting key sources and sinks, with different Parties using different tiers for different sources and sinks, according to capacity.
- Increasing quality and accuracy of reporting for land sector sources and sinks (i.e. using higher IPCC tiers for key categories where possible).
- Provision of up-front information alongside intended nationally determined contributions that promotes transparency, clarity and understanding.
- Flexibility in some aspects of the reporting and accounting framework and acceptance of different entry points for different countries, to accommodate the different national circumstances and capacities of countries.
- Focus on cost-effective reporting and accounting.
- Recognition of need of means of implementation to increase reporting and accounting capacity in developing countries.

Land-specific elements (relevant to the land sector only)

- Increasing coverage over successive cycles of nationally determined contributions for accounting of anthropogenic sources and sinks (with existing comprehensive accounting of non-CO₂ emissions from agriculture to continue for Annex B Parties).
- Provisions to address age-class structure effects in forests and the risk of natural disturbances and reversals of sequestered carbon from forests and other land sinks.
- Use of a “once in, always in” rule for coverage of sources and sinks.
- Accommodate mitigation contributions expressed relative to reference levels or using intensity metrics relating to agriculture, forestry and soils, with a view to providing cost-effective accounting options that take into account national circumstances.
- Technical assessment of reference levels where appropriate to increase confidence in the baselines against which progress is tracked.
- Reporting of qualitative information on a Parties’ vision for the land sector and the multiple benefits of policies and environmental and social safeguards (where applicable), to complement the quantitative accounting framework.

Reporting can provide the technical information necessary to undertake accounting. Information on anthropogenic GHG emissions and removals could be reported on a regular basis (e.g. annually) by all Parties, perhaps with additional flexibility for Least Developed Countries (LDCs) and Small Island Developing States (SIDSs). Reports would be prepared in accordance with IPCC methodologies agreed by the COP (as for other sectors). Use of 2006 IPCC guidelines for inventory reporting by all Parties would help to ensure that the information on which accounting is based is transparent, accurate, consistent, comparable and complete. The IPCC guidelines for GHG inventories are periodically updated and expanded to reflect the latest developments in scientific understanding and data availability.

An effective future land sector reporting and accounting framework would have broad coverage of key sources and sinks of anthropogenic GHGs from agriculture, forestry and other land uses. This would help to avoid selective inclusion of anthropogenic GHG emissions and removals for certain types of land or activities, or “cherry-picking”, by governments. It would ensure that the reporting and accounting

framework best represents all anthropogenic emissions and removals without creating perverse outcomes, and incentivises governments to take a holistic approach to land sector mitigation (Canaveira, 2013). This in turn could help to minimise indirect emissions caused by the shifting of emissions-intensive activities from one area inside the accounting framework to another outside it (e.g. in the case of bioenergy). Regarding the total area of land covered, countries could be encouraged to report the quantity of unmanaged land in their jurisdictions as a matter of best practice, to enable a complete picture of land-use changes to be built up over time (Canaveira, 2013).

Some aspects of the land sector reporting and accounting framework would continue to be flexible in order to take into account the different national circumstances and reporting and accounting capacities of countries. There are different ways in which flexibility could be included, such as:

- How the land sector is treated within nationally determined contributions (with a view to moving towards broad coverage of key sources over time).
- The definitions used of terms such as “forest” (although these might be within a range of values, e.g. for percentage tree cover).
- The designation of areas of managed and unmanaged land.
- The approach used to determine the baseline or reference level against which progress in implementation will be measured.
- The possibility to expand the use of reference levels to other land management activities (i.e. beyond forest management) within the overall framework being adopted for nationally determined contributions.

While some flexibility will be necessary in order to create a reporting and accounting framework that is applicable to all Parties, there is also a risk that too much flexibility could result in Parties claiming emissions reductions that are not real or additional. The agreement of a shared direction of travel for land sector accounting, combined with the “once in, always in” rule, could help to ensure the environmental integrity of mitigation efforts.

Given the widely varying national circumstances of different Parties, it may be difficult to agree a single approach for setting baselines or reference levels for all nationally determined contributions in the land sector. While different Parties could use different approaches for establishing reference levels (e.g. historical base years, simple extrapolations of recent trends, advanced projections), a high level of transparency would help to increase clarity and understanding of the baselines or reference levels used. Decision 12/CP.17 calls for developing countries to provide “transparent” and “complete” information on their forest reference levels and/or forest reference emissions levels, including historical data used to construct the reference level, data sets or assumptions used, a description of changes since the previous submission, the definition of forest used, and reasons why significant pools or activities were omitted if applicable (UNFCCC, 2011d). Similar data could be provided in the post-2020 period.

Projected reference levels can be used to factor out non-anthropogenic impacts such as CO₂ fertilisation and nitrogen deposition but also imply high uncertainties regarding projected harvesting levels. While the use of reference levels so far only applies to forest management, an expansion of this approach to other land sector categories is possible if consistent with the overall approach being adopted for national contributions.

The processes established for technical assessment of FMRLs under the Kyoto Protocol and forest reference levels and forest reference emissions levels for developing countries under REDD+ have helped

to build confidence in the accuracy of the information provided. Similar technical review cycles could be continued in the post-2020 period.

Mitigation in the land sector cannot be a substitute for action to reduce emissions from fossil fuel combustion. Deep and cost-effective cuts in GHG emissions from all sectors are needed if the below 2 °C long-term global goal is to be kept within reach. In the case of economy-wide nationally determined contributions, the inclusion of the land sector within a well-designed and cost-effective reporting and accounting framework should enable Parties to achieve more ambitious mitigation goals and not provide accounting loopholes or otherwise weaken the level of ambition of nationally determined contributions.

Accounting in the context of the Kyoto Protocol is mainly focused on quantitative data on anthropogenic GHG emissions and removals, as well as GHG units from market mechanisms or other metrics for measuring progress in implementation of mitigation targets and actions (Hood, Briner and Rocha, 2014). However, one of the guiding principles for LULUCF accounting under the Kyoto Protocol is that “the implementation of [LULUCF] activities contributes to the conservation of biodiversity and sustainable use of resources” (UNFCCC, 2005). While the accounting framework itself may focus on mitigation only, a well-designed framework can incentivise actions with other benefits, such as climate-friendly urban land planning, ecosystem-based adaptation and climate-smart agriculture (Box 2). In addition to climate change benefits, such actions could contribute towards achievement of the sustainable development goals (SDGs) currently being developed following the Rio+20 conference in 2012. As of August 2014, the draft list of possible SDGs includes goals to promote sustainable agriculture, make cities resilient and sustainable, sustainably manage forests, and halt land degradation and biodiversity loss (UN, 2014).

Reporting qualitative information on multiple benefits alongside the quantitative accounting framework could encourage countries to adopt policies with multiple benefits and provide recognition for such policies. Several Parties, including Brazil, China, the Philippines, the EU, the US and Japan, have highlighted the importance of incentivising non-carbon benefits in recent UNFCCC submissions on REDD+ (UNFCCC, 2014c). In some cases, these benefits may contribute to the permanence of forests by decreasing the risk of reversals (WWF, 2014).

Box 2: Reporting of qualitative information relating to the land sector

As a complement to the quantitative accounting framework, qualitative information could be reported in the following areas:

- Urban land planning
- Ecosystem-based adaptation
- Climate-smart agriculture
- Climate-resilient landscapes
- Social and environmental safeguards (where appropriate)

A key driver of land-use change is the rapid expansion of cities in many regions, also known as urban sprawl, which is influenced by **urban land planning**. Since the 1950s, the urban land area in non-OECD countries has increased fivefold (OECD, 2009) and the demand for land for built-up areas is expected to increase faster than the actual population size in 30 of 34 OECD countries (OECD, 2012). Urban areas are vulnerable to impacts from climate change due to their location (often on the coast), infrastructure, and warming is amplified within cities due to the urban heat island effect (OECD, 2009). Urban land planning should incorporate climate change considerations and aim at decreasing future land consumption. The introduction of policies fostering urban densification, e.g. via a BAU baseline or emission intensity per capita, can lead to significant reductions in anthropogenic GHG emissions. This concept of “compact cities” also has wider social and economic benefits and can thereby contribute to sustainability within an urban context.

Ecosystem-based adaptation acknowledges the role of biodiversity and ecosystem services in building and enhancing resilience and reducing vulnerability. Examples include wetland restoration and biodiversity conservation (Adaptation Committee, 2013). **Climate-smart agriculture** aims at enlarging agricultural productivity in a sustainable manner, while reducing greenhouse gases and adapting to climate change. Examples of climate-smart agriculture include reduced or no tillage with direct seeding and permanent soil cover, or better drought management for example by use of manure (FAO, 2013).

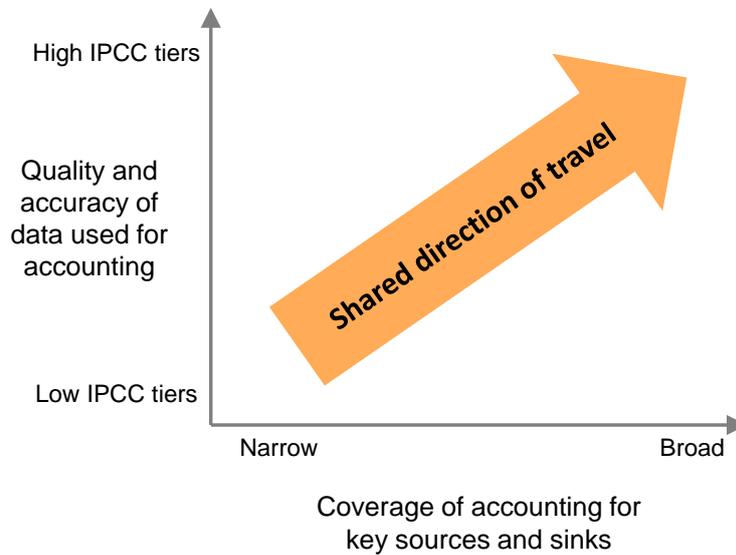
Climate-resilient landscapes are part of a broader landscape approach which puts emphasis on maintaining or achieving a healthy ecosystem for the provision of ecosystem services. Climate-resilient landscapes are able to absorb shocks and changes of climate without losing its functionality (Sekhran, 2010). A recent conference on “Landscapes for People, Food and Nature in Africa” highlighted the need for integrated landscapes that address the inter-linked challenges of food security, ecosystem services, biodiversity, climate change and water (Esipisu, 2014). Such solutions include scaling up landscape-level interventions such as terracing, agroforestry, reforestation, cultivation of local varieties, landslide prevention, riverbank stabilisation and watershed management (Munang, 2014). The 2015 agreement could encourage Parties to pursue national strategies that promote non-carbon benefits and to share information on these benefits with other Parties in the UNFCCC.

Social and environmental safeguards aim to protect the rights of indigenous peoples and other stakeholders whose livelihoods depend on the land sector. These safeguards would mainly apply to forestry-related supported actions and could build upon the set of safeguards established for REDD+ at COP 16 (UNFCCC, 2010). These include provisions such as ensuring that actions are consistent with national programmes, that governments respect the knowledge and rights of indigenous peoples, that stakeholder participation is full and effective, and that actions conserve natural ecosystems and protect biodiversity

3.2 A shared direction of travel for land sector reporting and accounting

A foundation for the post-2020 land sector reporting and accounting framework could be for all Parties to agree a shared direction of travel in terms of increasing the quality of reporting while widening the coverage of accounting over time (Figure 1). While these are two important dimensions of the reporting and accounting framework, Table 5 outlines some of the other possible dimensions. The new reporting and accounting framework should build on what is already in place under the Convention and the Kyoto Protocol, taking into account the strengths of each system. The land sector reporting and accounting framework will be an important component of the broader accounting framework, which would address other issues such as the MRV of information on actions and support and the use of market and non-market mechanisms.

Figure 1. A shared direction of travel for land sector accounting



Countries might progress along each the dimensions outlined in Table 5 independently. There would be no fixed order in which dimensions are to be addressed: some Parties might choose to expand their coverage first, others might focus on using higher IPCC tiers first, etc. While there would be flexibility in terms of how Parties address these dimensions, and different Parties may choose different pathways, the shared direction of travel would be common to all Parties. The process would be iterative, with Parties starting at different points and improving from there.

Parties with lower capacity would use lower IPCC reporting tiers, relying heavily on default emissions factors. Data availability is likely to be limited in terms of geographical coverage and time, perhaps covering one or two regions with long gaps between years for which data is available. The coverage of reporting and accounting would depend on national capacity and experience. The provision of finance, technology and capacity building activities, such as training courses for staff to learn how to use land sector monitoring technologies and data processing software, would be crucial for low capacity countries to increase the comprehensiveness of their land sector accounting.

Table 5. Possible dimensions of the land sector reporting and accounting framework

	Dimension	Options/comments
<i>Reporting</i>	Coverage of reporting of anthropogenic emissions and sinks in AFOLU sector	Coverage of reporting of key sources and sinks to be expanded over time in line with increasing capacity
	IPCC tier methodologies used for reporting	<ul style="list-style-type: none"> • Tier 1 – default emissions factors from IPCC emissions factors database • Tier 2 – increased use of country-specific emissions factors • Tier 3 – country-specific emissions factors and modelling (Different tiers can be used for different sources and sinks)
	Raw data used for reporting	<ul style="list-style-type: none"> • National statistics, typically highly aggregated data with low spatial resolution • Annual land use change statistics, higher resolution • High resolution, geo-tracked time series data
<i>Accounting</i>	Scale of contribution	<p>The overall accounting approach used by Parties:</p> <ul style="list-style-type: none"> • Project approach: Sub-national projects, policies or measures • Sectoral approach: Sub-national, sector-specific approach or projects within sectoral baselines, or use of reference levels to address legacy effects • National approach: National GHG accounting or national targets for land sector
	Coverage of key categories	<ul style="list-style-type: none"> • Some key categories • All key categories • Key categories and other sub-categories and/or nested activities chosen by Parties
	Separating impact of anthropogenic activities from natural effects	<ul style="list-style-type: none"> • Use of GHG inventories and managed land proxy • Land-based approach, with progressive implementation of specific provisions e.g. natural disturbances provision • Activity-based approach, with increasing coverage of activities over time
	Cost-effectiveness	If the aim is to broaden participation in land sector accounting then cost-effectiveness is an important dimension. Cost-effectiveness is linked to materiality, since a rigid approach that accounts for every last tonne of CO ₂ -eq would be costly to implement and would risk deterring action on the ground. Cost-effectiveness can also enable mitigation accounting to accommodate multiple land-use objectives.

Parties with greater coverage of key sources and sinks and higher quality and accuracy of data (corresponding to higher IPCC tiers) could consider expanding the coverage of land sector accounting and putting forward nationally determined contributions expressed relative to sectoral baselines or reference levels. Parties with the greatest capacity would use Tier 2 or Tier 3 IPCC methodologies and make use of advanced monitoring technologies coupled with in-house analytical expertise.

4. Near-term steps to COP 21 and beyond

This section outlines some near-term steps and decisions that could be taken at COP 20 and beyond to put governments on a path towards achieving the long-term vision set out in Section 3. A significant upcoming event in the UNFCCC calendar will be COP 21 in Paris in 2015, at which a new protocol, another legal instrument or an agreed outcome with legal force is to be adopted. The 2015 agreement could outline the foundations for post-2020 land sector reporting and accounting, with more detailed principles and/or guidelines to be agreed subsequently in the period 2016-2020.

4.1 COP 20, Lima

Parties could agree at COP 20 what up-front information specific to the land sector is to be provided alongside intended nationally determined contributions (which are to be communicated by the first quarter of 2015 by Parties ready to do so). Given the diverse nature of nationally determined contributions, up-front information will play an important role in increasing understanding, clarity and transparency of the actions proposed.

The up-front information needed to understand mitigation targets and goals is outlined in Briner and Prag (2013) and Levin et al. (2014). In the case of nationally determined contributions expressed relative to baselines or reference levels (which could be economy-wide contributions, contributions in the land sector only, or for sub-sectors within an economy-wide contribution), up-front information on the assumptions underpinning the baselines or reference levels is needed in order to understand the expected impact of the contributions. For land sector contributions in the form of qualitative policies and measures in developing countries, information could be provided on how evidence of progress in implementation will be measured, reported and domestically verified.

The provisions for up-front information could also provide an opportunity to report non-carbon benefits of the actions proposed. For the land sector, these could include ecosystem-based adaptation, climate-smart agriculture and the creation of climate-resilient landscapes. Such information would help to provide context for how nationally determined contributions fit within broader visions for the land sector, as well as links between mitigation and adaptation components.

There is currently no formal work stream for discussing post-2020 land sector accounting issues under the ADP. A space for negotiations on this issue under the ADP is needed if the 2015 agreement is to contain provisions relating to land sector reporting and accounting. At COP 20 in Lima in December 2014, therefore, Parties could agree to establish a work stream or other formal venue to start discussions on this important topic.

4.2 COP 21, Paris

At COP 21 in Paris, Parties are to adopt the 2015 agreement which will lay out the shape of the post-2020 international regime for tackling climate change. The agreement itself may leave some technical details regarding the accounting framework to be agreed subsequently in 2016-2020.

Parties could agree at COP 21 on the foundations (e.g. underlying principles and/or guidance) for post-2020 land sector reporting and accounting. In particular, Parties could agree on the direction of travel for land sector reporting and accounting and put the negotiations on a path towards achieving the long-term vision outlined in Section 3. Possible foundations that could be included in the 2015 agreement are outlined below.

Reporting

- The quality of GHG inventories should be improved over time, with a view to achieving annual GHG inventories of key sources and sinks by all Parties (with flexibility for LDCs and SIDSs). Parties are to use the 2006 IPCC Guidelines when preparing GHG inventories, to ensure that the reported information is as transparent, accurate, complete, consistent and comparable as possible. Some developing countries may need enhanced support in terms of finance, technology and capacity building to increase their GHG inventory capacity.
- GHG inventories are to be reviewed or analysed by technical experts, in order to increase confidence in the information reported and accelerate the inventory improvement process.

- Qualitative information on landscape management strategies and progress in non-mitigation policy areas (such as ecosystem-based adaptation, biodiversity conservation and food security) should be reported in national communications and biennial (update) reports to complement the quantitative accounting framework. In the case of some supported actions in developing countries, qualitative information on social and environmental safeguards should be reported.

Accounting

- The direction of travel for all Parties should be towards increased coverage over time of key categories of anthropogenic GHG sources and sinks from agriculture, forestry and other land-use change in accounting for mitigation contributions, taking into account the different starting points and capabilities of Parties.
- The “once in, always in” rule is to be applied to accounting for land sector sub-sectors.
- Both GHG emissions and removals from the land sector are to be accounted for.
- Accounting approaches are to be cost-effective and avoid perverse incentives (see e.g. New Zealand, 2014b).
- Technical assessment cycles are to be established for the baselines or reference levels used for accounting purposes, with the aim of increasing confidence in the baselines or reference levels against which progress in implementation is measured.

4.3 2016-2020

In an ideal world, the rules and details of a reporting and accounting framework would be agreed before the intended nationally determined contributions themselves are put forward. However, given the short time remaining until COP 21, these processes may need to take place in parallel and negotiations on some details could continue in the period 2016-2020. Issues that could continue to be worked on in 2016-2020 include: guidance for reference levels (including how these could promote sustainable development), treatment of non-permanence and natural disturbances, identification of anthropogenic emissions and removals, and the role of the land sector in market and non-market mechanisms under the UNFCCC.

A distinction can be made between tools and rules. For example, IPCC Guidelines can be considered a set of tools designed to increase the accuracy and comparability of GHG inventories. The COP subsequently adopted rules stipulating which IPCC Guidelines are to be used by which Parties. Similarly, it could be helpful to develop a set of additional tools in 2016-2020 that facilitate land sector reporting and accounting by all Parties. In the absence of agreement of rules on land sector reporting and accounting, Parties could opt in to use such tools voluntarily. Such tools could be developed by non-State actors through consultative processes and subsequently adopted as *de facto* standards by the UNFCCC process later. For example, guidelines developed by the European Commission Joint Research Centre were used voluntarily by 14 countries to calculate their FMRLs for the second commitment period (UNFCCC, 2011a).

Guidance for reference levels

Reference levels could be used to measure progress in implementation of post-2020 nationally determined contributions. In particular, the use of reference levels can help to minimise the impact of legacy effects and age-class structure for forestry and can potentially be used more broadly to accommodate multiple land use objectives, for example by accommodating food production emissions within baselines. Guidance for reference levels could be developed in 2016-2020, building on existing guidance for FMRLs under the Kyoto Protocol and forest reference levels/forest emissions reference levels for REDD+. A starting point could be to identify the elements needed for the construction of reference levels, as well as what should be included and what excluded. These elements can include historical data from GHG inventories, policy base

year, age-class structure (for forests), factoring out anthropogenic effects from natural ones, activities already undertaken (if applicable), projected activities under business-as-usual, and continuity of previous activities (Hood, Briner and Rocha, 2014). Guidance would also be needed on aspects such as whether new forest or reduced deforestation should be credited, and if so, how much time should pass until they are included in the reference level. Countries could also be encouraged to design baselines that create synergies with sustainable development and climate change adaptation, while avoiding perverse incentives for land management activities.

Some Parties could also decide to construct reference levels for non-forestry activities, such as agriculture, revegetation, cropland management, grazing land management and wetland drainage and rewetting. On one hand, a “reference levels for all” approach could provide flexibility and comparability, and new lands/activities could be added incrementally (Hood, Briner and Rocha, 2014). On the other hand, Estrada et al. (2014) point out that expanding the reference level idea to other categories could increase inconsistency with the type of contribution that a country is adopting for other sectors.

Non-permanence and natural disturbances

Options to deal with non-permanence and the risk of reversals of CO₂ removals from forestry and other land use are given below. The first two are more relevant to national-scale commitments, the others to projects:

- Use of GHG inventories as the basis for accounting, with removals counted as removals in the year they occur, and any subsequent reversals counted as emissions in the year they occur. This would be the simplest and most practical option, but may lead to less ambitious headline numbers for nationally determined contributions (Estrada et al., 2014).
- Use of a natural disturbances provision, whereby emissions resulting from a natural disturbance may be reported but not accounted for by the Party concerned. By 2020, experience will already have been accrued with this approach from the second commitment period under the Kyoto Protocol.
- Use of a buffer of GHG emissions reductions from forestry and other land-use changes that is backed up by national governments (Ellis, 2001). When emissions reductions from forestry and other land use are achieved, a share of the units generated could be set aside in a buffer. In the event of a reversal, units from the buffer could be used to make up the shortfall. While this option has been proposed for project-based mechanisms such as the CDM (UNFCCC, 2014d), the concept could also be implemented at larger (e.g. sub-national) scales (see Box 3).
- Issuance of temporary GHG units for removals from forestry and other land-use changes, for use by the Party concerned to meet its contribution or to be sold to another Party (Ellis, 2001). These temporary units could expire at the end of the contribution period, or remain valid at the end of the contribution period if there is verification that no removals have occurred.
- Use of insurance mechanisms, whereby the risk of reversals is underwritten by a third party for a fee (Murray et al., 2012). In the event of a reversal, the insurance company would make a payment to the Party concerned, and this money could be used to finance an equivalent quantity of emissions reductions elsewhere. The inclusion of a third party in the process could result in higher transaction fees and the insurance company could contest the fact that the reversal was beyond the control of the Party concerned.

Box 3: Buffering mechanisms

Forests are subject to natural disturbances and other changes in forest carbon cycles which remain unforeseeable. In order to ensure environmental integrity under a carbon credit regime, buffers can be used as part of a comprehensive risk strategy. Buffers are set-aside emission reductions that can be utilised to compensate reversals. There are several risks that have emerged under REDD+ that could be addressed via buffering mechanisms, including:

- risk of leakage
- unclear land tenure
- risk of methodological errors
- incorrect assumptions for the construction of reference levels or a MRV framework.

Emission reductions that are reserved in a buffer pool could be used in the following cases:

- a natural disturbance such as fire causing a reversal
- a major mistake in a Party's accounting system – the buffer could be used to reduce issued emission reductions while not affecting traded emission reductions
- a strong increase in deforestation in neighboring countries which could lead to leakage – in this case countries could pool their buffers to share risk.

If none of the above risks occur, buffered emission reductions can be converted into credited emission reductions after a certain period of time. Further, in the event of a change to a more ambitious global mitigation goal, a country could choose to cancel part of its buffer. The use of buffers is comparable to a risk insurance system that can incentivise non-carbon benefits. Estimating appropriate buffers can be problematic but if recurring over- or under-estimation occurs the buffer can be adjusted accordingly.

Source: Bucki, 2014; Ellis, 2001

Identification of anthropogenic emissions and removals

The concept of managed and unmanaged land is currently used as a proxy for anthropogenic and natural emissions and removals. Options for estimating anthropogenic emissions and removals in the future include (IPCC, 2009):

- Continued use of the managed land proxy.
- Quantification of the contribution of different drivers towards emissions and removals in the land sector. Scientific methods for doing this are being developed.
- Comparison between two or more modelled time series representing different levels of human land management.
- Use of default emissions factors for human and natural processes, together with improved statistical detection and attribution techniques (known as “optimal fingerprinting”).
- Expanded use of the activity-based approach for accounting, to encompass all human activities in the land sector that result in GHG emissions or removals. This could potentially be more transparently embedded within GHG inventories and a clear mapping provided of how the coverage of the activity-based approach relates to that of the land-based approach.

An IPCC expert meeting revisited the managed land proxy in May 2009, and concluded at that time that continued use of the managed land proxy remained the only practicable method available (IPCC, 2009). Nevertheless, the expert meeting also agreed that the managed land proxy “could in the future include an

increasing proportion of natural and indirect human contributions [and therefore] work needs to continue to identify and test approaches to separating anthropogenic impacts from others". This topic could be revisited again in the 2016-2020 period to take stock of scientific advances in this area and to reconsider whether the managed land proxy remains the most effective method available.

Use of market mechanisms

Some Parties may wish to use market mechanisms as a tool to finance and/or incentivise mitigation actions in the land sector in the post-2020 period. Further, inclusion of the land sector could also help to create deeper and more liquid carbon markets, given the significant abatement potential that exists in this sector. The scope and nature of market mechanisms under the UNFCCC in the post-2020 period remains unclear. There are currently three parallel streams in the UNFCCC negotiations which could be relevant: (i) the new market mechanism, (ii) the framework for various approaches, and (iii) non-market approaches. Discussions of all three topics are currently taking place under the Subsidiary Body for Scientific and Technological Advice (SBSTA). Parties have agreed that these various mechanisms under the UNFCCC are to stimulate mitigation across "broad segments of the economy" (UNFCCC, 2012). This is likely to include the land sector, particularly in developing countries.

Confidence in the environmental integrity of tradable GHG units from the land sector could be enhanced by robust technical reviews of baselines and reference levels, as under the REDD+ mechanism. Up-front information would also be needed on the approach used to deal with non-permanence and the impact of natural disturbances. While high standards of environmental integrity would be expected for GHG units originating from the land sector, setting the bar for participation too high (e.g. by requiring Tier 3 IPCC methodologies for the relevant sources or sinks) would make it challenging for many Parties to participate and would risk decreasing the total level of mitigation achieved from this sector. Any guidance or development of standards could draw on experience to date under the UNFCCC as well as from voluntary carbon markets.

5. Conclusions

How emissions and removals from the land sector are reported and accounted for in the post-2020 period will have a significant influence on the effectiveness of the 2015 agreement. This is because CO₂, CH₄ and N₂O emissions from agriculture, forestry and other land use are the second largest source of anthropogenic GHG emissions after the energy sector (IPCC, 2014a). In particular, non-CO₂ emissions from agriculture are rising rapidly and are now a greater GHG contributor than deforestation (Christ, 2014). Moreover, there is significant emissions abatement potential in the global land sector. This abatement potential is enhanced by the fact that, in some cases, forestry and other land use can act as a net sink of CO₂.

The LULUCF part of the land sector has several features that make it different to other sectors. These include strong legacy effects due to forest structure, and risk of natural disturbances causing reversals of carbon removals by land sinks. Further, both agriculture and LULUCF can have multiple competing policy objectives and relatively high uncertainty associated with estimates of emissions and removals. A cost-effective reporting and accounting framework is needed that respects these important differences, while enabling governments to gain recognition for nationally determined mitigation actions undertaken in the land sector.

Accounting in the context of the UNFCCC is more than simply a book-keeping exercise. The accounting framework can provide incentives to pursue some actions and not others. An accounting framework is needed that incentivises governments to undertake as much mitigation in the land sector as possible, while meeting other policy objectives such as adaptation, preservation of biodiversity, food security and poverty alleviation.

Several reporting and accounting frameworks for the land sector currently exist. These include reporting of anthropogenic GHG emissions and removals under the Convention, reporting and accounting for agriculture and LULUCF activities under the Kyoto Protocol, reporting and accounting for afforestation and reforestation projects under the CDM, and reporting on REDD+. There is no internationally-agreed accounting framework for the mitigation targets and actions put forward for 2020 under the Cancun Agreements, or for the intended nationally determined contributions put forward for the post-2020 period. In many cases how the land sector component of these targets and actions will be accounted for remains unclear.

In some areas there are overlaps between existing reporting and accounting systems in terms of coverage. For example, afforestation and reforestation activities are covered by the LULUCF, CDM and REDD+ arrangements under the Kyoto Protocol. In other areas there are differences; for example, CH₄ and N₂O emissions from agriculture are included in the reporting and accounting framework for Annex B Parties, but no internationally-agreed accounting framework for agriculture (or any other sector) currently exists for non-KP Annex I Parties or developing countries. In future, convergence between these various work streams could lead to a simpler and more comprehensive land sector reporting and accounting system.

A long-term vision for post-2020 land sector reporting and accounting is laid out in this paper, building on recent studies on land sector accounting and the 2015 agreement. The vision is of a land sector reporting and accounting framework that is applicable to all countries, taking into account their national circumstances. The framework would encourage countries to take on increasing responsibility for emissions and removals in the land sector over time as cost-effectively as possible. It would create incentives to move towards greater coverage of key sources, both in terms of reporting and accounting, and would not penalise countries for their initial starting points. Some developing countries would need capacity building to improve the quality and accuracy of their GHG reporting and accounting systems.

The coverage of the future land sector reporting and accounting framework should include as many key sources and sinks as possible. This would help to avoid “cherry-picking” of mitigation activities, provide incentives to take a holistic approach to mitigation in the land sector and help to ensure that the reporting and accounting framework reflects only anthropogenic impacts on sources and sinks. It will take time to achieve a broad reporting and accounting framework. Therefore Parties could gradually increase coverage over time on a “once in, always in” basis.

At present there is not an internationally-agreed approach for setting baselines or reference levels for the land sector in the post-2020 period. Therefore a high level of up-front transparency is needed to ensure clarity and understanding of the intended nationally determined contributions proposed. Up-front information on the assumptions and calculations used to construct baselines or reference levels, coupled with technical expert review of the reference levels as under the existing Kyoto Protocol and REDD+ mechanisms, could help to achieve this.

Near-term steps could be taken at COP 20 and beyond to put Parties on a pathway towards achieving the long-term vision outlined in this draft paper. At COP 20 in Lima, Parties could agree to create a work stream under the ADP to discuss land sector accounting issues and decide on the up-front information to be provided alongside intended nationally determined contributions in the land sector, including information on the assumptions underlying reference levels. At COP 21 in Paris, Parties could agree to lay out a set of foundations for post-2020 land sector reporting and accounting as part of the 2015 agreement. Possible elements for such foundations could include agreement that:

- All Parties are to use IPCC 2006 Guidelines for reporting (with different Parties using different tiers for different sources and sinks, according to capacity)

- The coverage of land sector accounting in terms of gases and lands should be expanded over time, using the “once in, always in” rule, with a view to achieving broad coverage of key sources of GHG emissions and removals from agriculture, forestry and other land uses.
- Option to use reference levels and/or intensity metrics to track progress towards mitigation contributions relating to agriculture, forestry and soils, with a view to providing cost-effective accounting options that take into account national circumstances.
- Technical assessments cycles are to be undertaken for intended baselines or reference levels, building on existing technical review processes under the Kyoto Protocol and REDD+.
- Qualitative information is to be provided on environmental and social safeguards (and efforts to pursue holistic landscape-based approaches such as ecosystem-based adaptation and climate-smart agriculture, to complement the quantitative accounting framework.
- Flexibility in some aspects of the reporting and accounting framework and acceptance of different entry points for different countries, to accommodate the different national circumstances and capacities of countries.
- Enhanced capacity building is needed in developing countries to improve reporting and accounting capacity.

Once the basic foundations for post-2020 land sector reporting and accounting have been established, work could be undertaken on the more technical details in the period 2016-2020. Further issues to be addressed in this period could include guidance for reference levels, how to deal with reversals caused by natural disturbances or indirect human effects, how to separate anthropogenic from natural emissions and removals, the role of the land sector in market and non-market mechanisms, and consideration of how multiple objectives can be accommodated in mitigation accounting (e.g. consideration of alternative approaches to agriculture accounting that are compatible with food production objectives).

References

- Adaptation Committee (2013), The State of Adaptation under the United Nations Framework Convention on Climate Change, http://unfccc.int/files/adaptation/cancun_adaptation_framework/adaptation_committee/application/pdf/ac_2013_report_low_res.pdf.
- Bateman, M. (2012), Insect outbreaks kill forests and release carbon, Livescience website, <http://www.livescience.com/18797-beetle-outbreaks-forests-carbon-nsf-bts.html> (accessed 18 July 2014).
- Bernard, F. et al. (Eds.) (2013), Towards a Landscape Approach for Reducing Emissions: A Substantive Report of the Reducing Emissions from All Land Uses (REALU) Project, World Agroforestry Centre - ICRAF, Nairobi, Kenya, http://asb.cgiar.org/PDFwebdocs/Substantive%20Global%20Report_REALU%20II_FINAL_15nov_2_standard.pdf.
- Briner, G. and A. Prag (2013), “Establishing and Understanding Post-2020 Climate Change Mitigation Commitments”, OECD/IEA CCXG Paper, http://www.oecd.org/env/cc/CCXG%20EstablishingandUnderstanding_%20final%20full%20docOct2013.pdf.
- Bucki, M. (2014), “Addressing risks in REDD+ through carbon payments and buffering rates”, in Broekhoven, Guido and Marieke Wit (eds.), *Linking FLEGT and REDD+ to Improve Forest Governance*, Tropenbos International.
- Canaveira, P. (2013), *Options and Elements for an Accounting Framework for the Land Sector in the Post-2020 Climate Regime*, Terraprima Report to the Swiss Federal Office for the Environment, February 2014, <http://www.terraprima.pt/en/projecto/11>.
- Carnegie Institution for Science (2014), Mapping reveals targets for preserving tropical carbon stocks, https://carnegiescience.edu/news/mapping_reveals_targets_preserving_tropical_carbon_stocks.
- Christ, R. (2014), *Statement by Renate Christ, Secretary of the IPCC*, ADP Technical Expert Meeting: Land use, Bonn, 11 June 2014, http://www.ipcc.ch/pdf/unfccc/sbsta40/140611_land_use_Christ.pdf.
- Clapp, C. and A. Prag (2012), *Projecting Emissions Baselines for National Climate Policy: Options for Guidance to Improve Transparency*, [http://www.oecd.org/env/cc/CCXG%20\(2012\)3%20National%20Baselines.pdf](http://www.oecd.org/env/cc/CCXG%20(2012)3%20National%20Baselines.pdf).
- Conway, D. (2014), *AFOLU in a post-2020 framework*, presentation at Nordic Council of Ministers side event, Bonn, 7 June 2014.
- Ellis, J. (2001), “Forestry Projects: Permanence, Credit Accounting and Lifetime”, *OECD/IEA AIXG Paper*, <http://www.oecd.org/env/cc/2467909.pdf>.
- ESA (2014), sentinel-1, ESA website, http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Sentinel-1/Radar_vision (accessed 24 July 2014).
- Esipisu, I. (2014), “African Leaders Urge to Link Landscapes to People”, *Food Tank*, <http://foodtank.com/news/2014/07/african-leaders-urged-to-link-landscapes-to-the-people>.
- Estrada, M. et al. (2014), *Land Use in a Future Climate Agreement*, prepared with support from cooperative agreement # S-LMAQM-13-CA-1128 with US Department of State, <http://merid.org/~media/Files/Projects/Advancing%20REDD/Land%20Use%20and%20ADP2%20online%20FINAL.pdf>.
- FAO (2010), *Global Forest Resources Assessment 2010*, <http://www.fao.org/forestry/fra/fra2010/en/>.
- FAO (2013), *Climate-Smart Agriculture Sourcebook*, <http://www.fao.org/docrep/018/i3325e/i3325e.pdf>.
- Funk, J. (2014), *Accounting for the land sector: implications of the past and possibilities for the future*, UNFCCC side event, Bonn, June 2014.
- GCF (2010), *Getting to the Roots, Underlying Causes of Deforestation and Forest Degradation, and Drivers of Forest Restoration*, <http://www.globalforestcoalition.org/wp-content/uploads/2010/11/Report-Getting-to-the-roots1.pdf>.
- GFOI (2013), *Integrating remote-sensing and ground-based observations for estimation of emissions and removals of greenhouse gases in forests: Methods and guidance from the Global Forest Observations Initiative*, http://www.gfoi.org/sites/default/files/MGD_copyedited09042014.pdf.
- GIZ (2013), *NAMAs and REDD+: Relationship and main issues for consideration - with a focus on Southeast Asia*, <http://mitigationpartnership.net/giz-2013-namas-and-redd>.
- Government of Brazil (2014), *Brazil's submission of a forest reference emission level for deforestation in the Amazonia biome for results-based payments for REDD+ under the UNFCCC*, http://unfccc.int/files/methods/redd/application/pdf/20140606_submission_frel_brazil.pdf.

- Hood, C, Briner, G., Rocha, M. (2014), “GHG or not GHG: Accounting for Diverse mitigation Contributions in the Post-2020 Climate Framework”, *OECD/IEA CCXG Paper*, http://www.oecd.org/env/cc/GHG%20or%20not%20GHG_CCXGsentout_May2014_REV.pdf.
- IPCC (1996), *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html>.
- IPCC (2000), *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.
- IPCC (2003), *Good Practice Guidance for Land use, Land-use Change and Forestry*, <http://www.ipcc-nggip.iges.or.jp/public/gp/lulucf/gp/lulucf.html>.
- IPCC (2006), *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.
- IPCC (2009), *Revisiting the Use of Managed Land as a Proxy for Estimating National Anthropogenic Emissions and Removals*, IPCC Expert Meeting Report, http://www.ipcc-nggip.iges.or.jp/public/mtdocs/pdffiles/0905_MLP_Report.pdf.
- IPCC (2014a), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, <http://mitigation2014.org/report/final-draft/>.
- IPCC (2014b), *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*, <http://www.ipcc-nggip.iges.or.jp/public/kpsg/index.html>.
- IPCC (2014c), *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*, <http://www.ipcc-nggip.iges.or.jp/public/wetlands/index.html>.
- Iversen P., D. Lee, and M. Rocha, (2014) *Understanding Land Use in the UNFCCC*, http://www.climateandlandusealliance.org/uploads/PDFs/Understanding_Land_Use_in_the_UNFCCC.pdf.
- Levin, K., D. Rich, J. Finnegan and Y. Dagnet (2014), “Ex ante Clarification, Transparency, and Understanding of Intended Nationally Determined Mitigation Contributions”, *WRI Working Paper*, <http://www.wri.org/publication/ex-ante-clarification-transparency-and-understanding-intended-nationally-determined>.
- Munang, R. (2014), *The Imperative for Landscape Approaches for Improved Food Security Climate Resilience in Africa*, presentation at the Landscapes for People, Food and Nature in Africa conference, July 2014, http://www.slideshare.net/Landscapes_PFN/richard-lpfn-the-imperative-for-landscape-approaches-for-improved-food-security-munang-rev-1july-2014.
- Murray, B. C., C. S. Galik, S. Mitchell and P. Cottle (2012), *Alternative Approaches to Addressing the Risk of Non-Permanence in Afforestation and Reforestation Projects under the Clean Development Mechanism*, <http://nicholasinstitute.duke.edu/sites/default/files/publications/alternative-approaches-to-addressing-the-risk-of-non-permanence-paper.pdf>.
- New Zealand Government (2014a), *New Zealand’s Greenhouse Gas Inventory 1990-2012*, <http://www.mfe.govt.nz/publications/climate/greenhouse-gas-inventory-2014/index.html>.
- New Zealand Government (2014b), *Submission to the Ad Hoc Working Group on the Durban Platform for Enhanced Action, Work Stream 1*, October 2014, http://www4.unfccc.int/submissions/Lists/OSPSubmissionUpload/106_99_130574180486501924-New%20Zealand%20Submission%20to%20the%20UNFCCC%20on%20the%20ADP%20Work%20Stream%201%20-%20Elements%20-%20October2014.pdf.
- OECD (2009), “Cities and Climate Change: Key Messages from the OECD”, <http://www.oecd.org/gov/regional-policy/44272199.pdf>.
- OECD (2012), “Compact City Policies: A Comparative Assessment”, Policy Brief, *OECD Green Growth Studies*, <http://www.oecd.org/regional/regional-policy/50524895.pdf>.
- Parker, C. et al. (2014). *The land-use sector within the post-2020 climate regime*, Nordic Council of Ministers, Norden, <http://www.norden.org/en/publications/publikationer/2014-520>.
- Sekhran, N. (2010), *Establishing Climate-Resilient Landscapes through Connectivity Corridors and Protected Area Integration*, <http://www.kruger2canyons.org/pdf%20documents/042%20-%20connectivity%20conservation.pdf>.
- Seidl, R. et al. (2014), Increasing forest disturbances in Europe and their impact on carbon storage, *Nature Climate Change*, <http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate2318.html>.

- UN (2014), *Outcome Document - Open Working Group on Sustainable Development Goals*, http://sustainabledevelopment.un.org/content/documents/4518SDGs_FINAL_Proposal%20of%20OWG_19%20July%20at%201320hrsver3.pdf.
- UNFCCC (2002), *Decision 18/CP.8: Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, part I: UNFCCC reporting guidelines on annual inventories*, FCCC/CP/2002/7/Add.2, <http://unfccc.int/resource/docs/cop8/07a02.pdf>.
- UNFCCC (2005), *Decision 16/CMP.1: Land use, land-use change and forestry*, FCCC/KP/CMP/2005/8/Add.3, <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf>.
- UNFCCC (2007), *Decision 2/CP.13: Reducing emissions from deforestation in developing countries: approaches to stimulate action*, FCCC/CP/2007/6/Add.1, <http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=8>.
- UNFCCC (2010), *Decision 1/CP.16: The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention*, FCCC/CP/2010/7/Add.1, <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf>.
- UNFCCC (2011a), *Synthesis report of the technical assessments of the forest management reference level submissions*, FCCC/KP/AWG/2011/INF.2, <http://unfccc.int/resource/docs/2011/awg16/eng/inf02.pdf>.
- UNFCCC (2011b), “Guidance on systems for providing information on how safeguards are addressed and respected and modalities relating to forest reference emission levels and forest reference levels as referred to in decision 1/CP.16”, in *Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011*, FCCC/CP/2011/9/Add.2, <http://unfccc.int/resource/docs/2011/cop17/eng/09a02.pdf#page=16>.
- UNFCCC (2011c), *Decision 2/CMP.7: Land use, land-use change and forestry*, FCCC/KP/CMP/2011/10/Add.1, <http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf>.
- UNFCCC (2011d), *Decision 12/CP.7: Guidance on systems for providing information on how safeguards are addressed and respected and modalities relating to forest reference emission levels and forest reference levels as referred to in decision 1/CP.16*, FCCC/CP/2011/9/Add.2, <http://unfccc.int/resource/docs/2011/cop17/eng/09a02.pdf#page=16>.
- UNFCCC (2012), *Decision 1/CP.18: Agreed outcome pursuant to the Bali Action Plan*, FCCC/CP/2012/8/Add.1, <http://unfccc.int/resource/docs/2012/cop18/eng/08a01.pdf#page=3>.
- UNFCCC (2013a), *Methodological guidance for activities relating to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries*, FCCC/SBSTA/2013/L.12, <http://unfccc.int/resource/docs/2013/sbsta/eng/l12.pdf>.
- UNFCCC (2013b), *Quantified economy-wide emission reduction targets by developed country Parties to the Convention: assumptions, conditions, commonalities and differences in approaches and comparison of the level of emission reduction efforts*, FCCC/TP/2013/7, <http://unfccc.int/resource/docs/2013/tp/07.pdf>.
- UNFCCC (2013c), *Compilation of information on nationally appropriate mitigation actions to be implemented by developing country Parties*, FCCC/SBI/2013/INF.12/Rev.2, <http://unfccc.int/resource/docs/2013/sbi/eng/inf12r02.pdf>.
- UNFCCC (2013d), *Decision 14/CP.19: Modalities for measuring, reporting and verifying*, FCCC/CP/2013/10/Add.1, <http://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf>.
- UNFCCC (2014a), CDM Project Cycle Search, UNFCCC website, <http://cdm.unfccc.int/Projects/projsearch.html>.
- UNFCCC (2014b), *Decision 14/CP.19: Modalities for measuring, reporting and verifying*, FCCC/CP/2013/10/Add.1, <http://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf#page=33>.
- UNFCCC (2014c), *Views on the issues referred to in decision 1/CP.18, paragraph 40, Subsidiary Body for Scientific and Technological Advice Fortieth session*, <http://unfccc.int/resource/docs/2014/sbsta/eng/misc04.pdf>.
- UNFCCC (2014d), *Options for possible additional land use, land-use change and forestry activities and alternative approaches to addressing the risk of non-permanence under the clean development mechanism*, FCCC/TP/2014/2, <http://unfccc.int/resource/docs/2014/tp/02.pdf>.
- WRI (2014a), *Global Forest Watch*, http://www.wri.org/sites/default/files/10-GFW_Brochure.pdf.
- WRI (2014b), *Media Advisory: Global Forest Watch Fires to Monitor Fires in South East Asia*, <http://www.wri.org/news/2014/07/media-advisory-global-forest-watch-fires-monitor-fires-southeast-asia>.
- WWF (2014), *Addressing methodological issues of non-carbon benefits and non-market-based approaches in REDD+*, Submission to UNFCCC SBSTA 40, <http://unfccc.int/resource/docs/2014/smsn/ngo/411.pdf>.

Glossary

ADP	Ad hoc Working Group on the Durban Platform for Enhanced Action
AFOLU	Agriculture, Forestry and Other Land Use
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
COP	Conference of the Parties to the UNFCCC
CP	Commitment Period
CRF	Common Reporting Format
EC	European Commission
EDF	Environmental Defence Fund
ESA	European Space Agency
EU	European Union
FCPF	Forest Carbon Partnership Facility
FIP	Forest Investment Programme
FMRL	Forest Management Reference Level
GFOI	Global Forest Observations Initiative
GFW	Global Forest Watch
GHG	Greenhouse Gas
GPG	Good Practice Guidance
HWP	Harvested Wood Product
ICRAF	International Centre for Research in Agroforestry
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
JRC	Joint Research Centre
KP	Kyoto Protocol
LDC	Least Developed Country
ICER	Long-term Certified Emission Reduction
LDC	Least Developed Country
LULUCF	Land Use, Land-use Change and Forestry
MGD	Methods and Guidance Document
MRV	Measurement, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Action
NIR	National Inventory Report
OECD	Organisation for Economic Co-operation and Development
REALU	Reduced Emissions from All Land Uses
REDD+	Reducing emissions from deforestation and forest degradation (and related activities) in
REL	Reference Emission Level
RL	Reference Level
RMU	Removal Unit
SBSTA	Subsidiary Body for Scientific and Technological Advice
SDG	Sustainable Development Goal
SEF	Standard Electronic Format
SIDS	Small Island Developing State
tCER	Temporary Certified Emission Reduction
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD	United Nations Initiative on Reducing Emissions from Deforestation and Forest Degradation

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