CLIM-FO Climate Change & Forestry

Electronic Journal and Newsletter June 2013

FAO, Forestry Department, Forest and Climate Change Team
Food and Agriculture Organization of the United Nations

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I. IN THE PRESS

1 June 2013 - CIFOR

Tenure security and economic interest add up to REDD+ effectiveness – study

Local communities must have secure tenure rights if they are to manage forests to reduce greenhouse gas emissions from deforestation — but they also need an interest in doing so, a study in Indonesia has found.

31 May 2013 - The Guardian

World's largest Redd project finally approved in Indonesia

Rimba Raya, the world's largest REDD+ project, has finally been approved by the Indonesian government and verified under the Verified Carbon Standard (VCS), a leading certification standard for carbon credits.

31 May 2013 - CIFOR

Bonn delegates to tackle impasse over REDD+ climate change negotiations

Negotiators attending a U.N. climate change conference next week are expected to propose setting up a REDD+ governing body, which could help provide a solution to how countries monitor, report and verify successful emissions reductions.

30 May 2013 - CIFOR

REDD+ projects fighting an uphill battle on tenure – study

Land conflicts between palm oil companies and communities in Indonesia. Squatters with no documentation of land rights in Brazil. Local leaders exploiting customary practices to gain favors in Tanzania. Encroachment into a national park by an agro-industrial company in Cameroon. Unclear rights to carbon in Vietnam.

30 May 2013 - Forest Trends

Maneuvering the Mosaic: State of the Voluntary Carbon Markets 2013

Voluntary demand for carbon offsetting grew 4% in 2012, when buyers committed more than $523 million to offset 101 million metric tonnes of greenhouse gas emissions. Private sector buyers flocked to offsets earned by planting trees, saving tropical forests, or distributing clean cookstoves in the developing world, according to this year's State of the Voluntary Carbon Markets report, released by Forest Trends' Ecosystem Marketplace this week in Barcelona, Spain.

27 May 2013 - CIFOR

Q + A: Sharing REDD+ "benefits"

International efforts to reduce forest loss and degradation through the U.N.-backed REDD+ scheme are poised to see significant benefits flow to forest-rich developing countries. But the latest study by the Center for International Forestry Research (CIFOR) suggests that such benefits may not be distributed in ways that are fair and socially inclusive.

24 May 2013 - IISD

Central African Countries Pledge to Improve SFM

The Center for International Forestry Research (CIFOR) in collaboration with the Government of Cameroon convened a regional conference on sustainable forest management (SFM) in Central Africa. The outcome of the conference is a declaration on the future of Central Africa's forests.

16 May 2013 - CIFOR

Can REDD+ drive change in DR Congo?

Implementing a U.N.-backed scheme to slow forest loss in the Democratic Republic of Congo will be difficult, a new study says, until the government addresses corruption, a lack of state authority in some regions, and intermittent fighting between rebels and government forces in the country's east.

16 May 2013 - IISD

FAO Conference Examines Role of Forests in Food Security

At the first International Conference on Forests for Food Security and Nutrition, participants examined the role of forests and agroforestry systems in supporting livelihoods around the world.

May 2013 - FAO

Winner of the photo contests Nurture forests for the future - REDD+ for food

FAO as part of the UN-REDD Programme is pleased to announce the winner of our Nurture Forests for the Future – REDD+ for Food photo contest. Ms. Lani Holmberg (Australia) with her image "Papaya trees and poverty fighting" showed how smallholders successfully cultivate trees as suppliers of fruits evidencing a clear relationship and relevance to the subject of the photo and the theme of the contest.

II. MULTILATERAL PROCESSES IN CLIMATE CHANGE

Ongoing events

Bonn Climate Change Conference

3-14 June, Bonn, Germany

The thirty-eighth sessions of the Subsidiary Body for Implementation (SBI 38) and the Subsidiary Body for Scientific and Technological Advice (SBSTA 38), as well as the third session of the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP 3) will be held at Maritim Hotel from 3-14 June 2013 in Bonn, Germany. **More**

III. EVENTS & MEETINGS

Upcoming events

Global Symposium: REDD+ in a Green Economy

19-21 June 2013, Jakarta, Indonesia

Activities related to reducing emissions from deforestation and forest degradation (REDD+) in developing countries can contribute significantly to rural development and to broader development objectives, and there is increasing demand for integrating REDD+ within green economy and green growth efforts. However, there is only nascent understanding and knowledge, both within international organizations and other REDD+ actors, and in developing countries, of how to establish mutually reinforcing links between ongoing REDD+ activities and a green economy transition. Over the past three years, the UN-REDD Programme has developed a body of work on 'Ensuring that REDD+ and a Green Economy transformation are mutually reinforcing', based on pilot activities in a number of partner countries. The Global Symposium aims to take stock of the lessons learned, with a view to provide key decision makers with a stronger rationale for linking REDD+ planning and REDD+ investments with green economy efforts. The Symposium will focus on the role of comprehensive land-use planning for capturing environmental, economic and social benefits from REDD+ investments. **More**

Africa Carbon Forum

3-5 July, 2013, Abidjan, Côte d'Ivoire

The Africa Carbon Forum is the prime carbon finance, trade fair and knowledge-sharing platform in Africa. It brings together a wide range of stakeholders interested and engaged in reducing greenhouse gas emissions: representatives from designated national authorities (DNAs), United Nations agencies, international development banks, governments and the private sector. **More**

Paving the Way to Sustainable Forest and Carbon Management

19 - 21 August 2013, Faculty of Forestry, Universiti Putra Malaysia, Malaysia

Arbonaut Ltd. in Finland and the Faculty of Forestry, Universiti Putra Malaysia (UPM) are pleased to invite you to the workshop Arbonaut Users Days 2013 (AUD'13) from 19 to 21 August, 2013. The 3-days workshop will take place at Faculty of Forestry, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor Darul Ehsan, MALAYSIA. The workshop will focus on basic LiDAR processing and LiDAR Assisted Multi-source Programme (LAMP) for forest inventory and REDD+. **More**

International Conference on Climate Change and Tree Responses in Central European Forests

1-5 September 2013, Zürich, Switzerland

The conference aims at exchanging the state of the art regarding direct (physical environment) and indirect effects (interspecific interactions) of climate change on the performance of trees and forest ecosystems. Topics to be discussed stretch from tree physiology and genetics to disturbances and community diversity, with a clear regional focus on Central Europe including the Alps and Carpathians. Keynotes on the response of trees/forest ecosystems to Climate Change (CC) in the focal region and in other regions of the world will frame the sessions, which are open for contributed talks. **More**

Forests Africa. Opportunities for a Green Economy

17 – 19 September, Nairobi, Kenya.

The United Nations Environment Programme (UNEP) and the Centre for International Forestry Research (CIFOR) will convene a three-day conference, Forests Africa: Opportunities for a Green Economy. The conference will be supported by the UN-REDD Programme, the World Agroforestry Centre and will be open for partnerships with other organizations. The event will provide a platform for key players from government, the private sector (formal and informal), civil society, media, as well as the research and development sectors, to openly discuss the challenges and opportunities that Africa's forests present for the development and comparative advantage of the continent and its transition to a Green Economy. The conference will aim to take a step toward repositioning forests within Africa's economic and political landscape. In transitioning to a Green Economy, Africa will require economic growth pathways that are diversified, generate greater employment, produce higher outputs with lower inputs, reduce environmental risks and enhance competitiveness for African economies. The conference will increase awareness of the challenges and opportunities for forests to contribute to green economies at the local, national and regional levels through sustainable management, REDD+, trade of forest products and services, and inclusive processes. It will also identify the range of enabling policies required. Delivering on such a goal will require coordinated collaboration among a broad range of policy and non-state stakeholders – especially those from outside the forestry sector. **More**

EFI 20 Years Science and Policy Forum

23 – 27 September, 2013, Nancy, France

European Forest Institute (EFI) celebrates its 20th anniversary in 2013. The commemoration is also an opportunity to develop an analysis of the future of our forests, and on how EFI and its partners can contribute to meet the challenges related to the various changes, risks and uncertainties to which the forests will be exposed. The EFI 20 Years Science and Policy Forum will stimulate balanced discussion between policy/decision makers, stakeholders and scientists on concrete issues related to the future of our forests, and the risks and opportunities their face. On 25 September, a high-level conference **"Our forests in the 21st century – ready for risks and opportunities?"** gathers both scientists and decision-makers. The follow-up of the conference on 26 September continues with a session "Risks to European Forests - What added value can a European Forest Risk Facility provide?" **More**

IV. RESEARCH ARTICLES

Impacts of selective harvest on the carbon sequestration potential in Moso bamboo (*Phyllostachys pubescens*) plantations

Kuehl, Y.; Li, Y.; Henley, G

Forests, Trees and Livelihoods; 2013. 22:1, 1-18

Bamboos are among the fastest growing and most renewable forest resources, and are widely grown throughout the tropics and the subtropics. Properties related to their growth and utilization are beneficial for climate change mitigation and adaptation. However, these aspects are yet to be extensively researched. This paper studies the carbon sequestration potential of bamboos, using the example of Moso bamboo (*Phyllostachys pubescens*), and examining the impacts of selective harvest. By using time-series data and allometric equations, the paper develops an original model to survey the biomass accumulation of a Moso bamboo plantation. The carbon sequestration potential of bamboo is compared to a fast-growing species that grows in similar conditions – Chinese fir (*Cunninghamia lanceolata*). The modelled data indicate that carbon sequestration of Moso bamboo would only exceed that of Chinese fir when bamboo is selectively harvested - as this allows effective utilization of bamboo's characteristics of fast growth and high renewability; the simulation showed that a selectively harvested Moso bamboo plantation sequesters 305.77 t C/ha in 60 years. Although this study generated essential findings to determine the potential role of bamboo in climate change mitigation, it also demonstrated the need for further research to enable stakeholders to utilize bamboo effectively in these efforts.

Sudden forest canopy collapse corresponding with extreme drought and heat in a Mediterraneantype eucalypt forest in southwestern Australia.

Matusick, G.; Ruthrof, K. X.; Brouwers, N. C.; Dell, B.; Hardy, G. St. J.

European Journal of Forest Research; 2013. 132: 3, 497-510

Drought and heat-induced forest dieback and mortality are emerging global concerns. Although Mediterranean-

type forest (MTF) ecosystems are considered to be resilient to drought and other disturbances, we observed a sudden and unprecedented forest collapse in a MTF in Western Australia corresponding with record dry and heat conditions in 2010/2011. An aerial survey and subsequent field investigation were undertaken to examine: the incidence and severity of canopy dieback and stem mortality, associations between canopy health and stand-related factors as well as tree species response. Canopy mortality was found to be concentrated in distinct patches, representing 1.5% of the aerial sample (1,350 ha). Within these patches, 74% of all measured stems (>1 cm DBHOB) had dying or recently killed crowns, leading to 26% stem mortality six months following the collapse. Patches of canopy collapse were more densely stocked with the dominant species, *Eucalyptus marginata*, and lacked the prominent midstorey species *Banksia grandis*, compared to the surrounding forest. A differential response to the disturbance was observed among co-occurring tree species, which suggests contrasting strategies for coping with extreme water stress. These results suggest that MTFs, once thought to be resilient to climate change, are susceptible to sudden and severe forest collapse when key thresholds have been reached.

Modeling climate change effects on soil respiration in three different stages of primary succession in deglaciated region on Gongga Mountain, China

Luo Ji; Chen YouChao; Zhu WanZe; Zhou Peng

Scandinavian Journal of Forest Research; 2013. 28: 4, 363-372

Primary succession in deglaciated region is the ideal environment for examining soil respiration (SR). In this study, we measured SR and employed a process-oriented model, Forest-denitrificationdecomposition (DNDC), to study responses of SR to climate change in three primary successional stages in deglaciated region on Gongga Mountain, China. Stand types included a hardwood stand (S1), a coniferous and broad-leaved mixed forest stand (S2), and a mature stand of *Abies fabri* (Mast.) Craib (S3). Four climate scenarios (Baseline, B1, A1 B, A2) reported by the Intergovernmental Panel on Climate Change were investigated. According to measured values, there was substantial temporal variation (coefficient of variation ranged from 49.7% in S1 to 61.4% in S3) and spatial variation (annual SR ranged from 2657+or-944 kg C ha^{-1} in S1 to 9228+or-1743 kg C ha^{-1} in S3) in the data. The modeled results showed that climate change affected the different stages to different extent in this region. Climate change will weaken the carbon sink strength of forest ecosystems in deglaciated region. The results have provided a better understanding on patterns of SR, and provided useful information on the magnitude and the response of SR to climate change in deglaciated region.

Satellite data-based phenological evaluation of the nationwide reforestation of South Korea

Jeong, S. J.; Ho, C. H.; Choi, S. D.; Kim, J.; Lee, E. J.; Gim, H. J

PLoS ONE; 2013. 8: 3, e58900

Through the past 60 years, forests, now of various age classes, have been established in the southern part of the Korean Peninsula through nationwide efforts to reestablish forests since the Korean War (1950-53), during which more than 65% of the nation's forest was destroyed. Careful evaluation of long-term changes in vegetation growth after reforestation is one of the essential steps to ensuring sustainable forest management. This study investigated nationwide variations in vegetation phenology using satellite-based growing season estimates for 1982-2008. The start of the growing season calculated from the normalized difference vegetation index (NDVI) agrees reasonably with the ground-observed first flowering date both temporally (correlation coefficient, r=0.54) and spatially (r=0.64) at the 95% confidence level. Over the entire 27-year period, South Korea, on average, experienced a lengthening of the growing season of 4.5 days decade(-1), perhaps due to recent global warming. The lengthening of the growing season is attributed mostly to delays in the end of the growing season. The retrieved nationwide growing season data were used to compare the spatial variations in forest biomass carbon density with the time-averaged growing season length for 61 forests. Relatively higher forest biomass carbon density was observed over the regions having a longer growing season, especially for the regions dominated by young (<30 year) forests. These results imply that a lengthening of the growing season related to the ongoing global warming may have positive impacts on carbon sequestration, an important aspect of large-scale forest management for sustainable development.

Predicting climate change impacts on the amount and duration of autumn colors in a New England forest

Archetti, M.; Richardson, A. D.; O'Keefe, J.; Delpierre, N

PLoS ONE; 2013. 8: 3, e57373

Climate change affects the phenology of many species. As temperature and precipitation are thought to control autumn color change in temperate deciduous trees, it is possible that climate change might also affect the phenology of autumn colors. Using long-term data for eight tree species in a New England hardwood forest, we

show that the timing and cumulative amount of autumn color are correlated with variation in temperature and precipitation at specific times of the year. A phenological model driven by accumulated cold degree-days and photoperiod reproduces most of the interspecific and interannual variability in the timing of autumn colors. We use this process-oriented model to predict changes in the phenology of autumn colors to 2099, showing that, while responses vary among species, climate change under standard IPCC projections will lead to an overall increase in the amount of autumn colors for most species.

Spatial heterogeneity of climate change in an Afromontane centre of endemism

Platts, P. J.; Gereau, R. E.; Burgess, N. D.; Marchant, R

Ecography; 2013. 36: 4, 518-530

Broad-scale assessments of how climate change might impact mountain ecosystems, especially in areas of high biodiversity and endemism, are compromised by the lack of localised climate feedback in global circulation models. Here, we use regionally downscaled climate models to highlight how spatial variation in forecast change could impact rare plant distributions differentially across the Eastern Arc Mountains of Tanzania and Kenya, part of the Eastern Afromontane Biodiversity Hotspot. Concordant with the theory that climatic stability facilitates the accumulation of rare species, we find significant positive correlations between endemic plant richness and future climatic persistence within the dispersal-limiting sky islands of this mountain archipelago. Further, we explore the hypothesis that mountain plants will move upslope in response to climate change and find that, conversely, some species are predicted to tend downslope, despite warmer annual conditions, driven by changes in seasonality and water availability. Importantly, two thirds of the modelled plant species are predicted to respond in different directions in different parts of their ranges, exemplifying the potential for individualistic responses of species and disjunct populations to environmental change, and the need for regional focus in climate change impact assessment. Conservation planners, and more broadly those charged with developing climate adaption policy, are advised to take caution in inferring local patterns of change from zoomed perspectives of broadscale models. Moreover, a preoccupation with mean annual temperature as the principal driver of ecosystem change is misguided and could compromise efforts to make conservation plans resilient to future climate change. Faced with spatially complex and inherently uncertain future conditions, sensible priorities are to restore forest connectivity and to underpin adaption strategies with knowledge of how ecosystems and people have adapted to previous episodes of rapid change.

Is land abandonment affecting forest dynamics at high elevation in Mediterranean mountains more than climate change?

Palombo, C.; Chirici, G.; Marchetti, M.; Tognetti, R.;

Plant Biosystems; 2013. 147: 1, 1-11

Global change is leaving a fingerprint on the appearance, structure and productivity of the treeline ecotone, modifying patterns of mountain ecosystems. In order to implement correct policies for managing natural resources, we examine how climate change interrelated with land-use abandonment could shape mountain forests at their upper limit in a Mediterranean environment, and how patterns of tree growth and periods of tree establishment guide the interpretation of global change effects on treeline dynamics. We reconstructed the population dynamics of mountain pine (*Pinus mugo* Turra spp. *mugo*) in the subalpine belt of the Majella National Park (Italy). In a test area of 14,440 ha, proposed as a pilot study site for long-term ecological monitoring, temporal and spatial mountain pine distribution were examined since 1954 by historical aerial ortophotos. Multitemporal maps documented the expansion upwards (1 m/year) and downwards (3 m/year) of mountain pine. Mountain pine started to expand upwards into the formerly tree-free grassland in early 1900s, in association with a decline of the local human population and livestock. Land-use change was the major driving force of vegetation dynamics at the treeline in the Majella massif.

Observed air/soil temperature trends in open land and understory of a subtropical mountain forest, SW China.

You GuangYong; Zhang YiPing; Schaefer, D.; Sha LiQing; Liu YuHong; Gong HeDe; Tan ZhengHong; Lu ZhiYun; Wu ChuanSheng; Xie YouNeng

International Journal of Climatology; 2013. 33: 5, 1308-1316.

This study seeks a further understanding on climate trends in a subtropical mountain forest, SW China. Air (T_a) and soil temperature (T_s), both in open land (1983–2010) and under a forest canopy (1986–2010), were investigated. Short-term radiation components were also measured simultaneously both in open land and understory to explore the relationships of microclimatic variables. Correlations of T_a and T_s with sunshine hours (S_t) and wind speed (W_s) were also analysed as driving factors of the temperature trends. The results showed that (1) Understory radiation components were greatly reduced by the forest canopy, showing a strong effect of forest canopy on microclimatic variables. T_s_0 in open land was significantly correlated with solar radiation.

Wind speed had significant influences on differences between T_a and T_s_0, between open land T_s_0 and understory T_s_0. The long-term data showed that T_s_0 under forest canopy were closely coupled with T_a in open land. (2) T_a had a larger increase than T_s_0 in open land, and temperature increases in winter were greater than in other seasons. Soil temperature at depths under forest canopy had nearly twice the increases of those on open land; we attributed this to the higher relative increase of W_s over S_t. (3) A slope change in 1998 was detected in the T_s_0 and T_a difference ($T_s\_0 - T_a$) series, suggesting different response of T_s_0 and T_a since that year. Deceleration of S_t and stability of W_s may have been factors. This study improves our understanding of warming in a nature reserve where anthropogenic influences are absent. Further studies are needed for the biological and biochemical implications on subtropical mountain forest.

Carbon benefits from protected areas in the conterminous United States

Zheng, D. L.; Heath, L. S.; Ducey, M. J.
Carbon Balance and Management; 2013. 8: 4

Background: Conversion of forests to other land cover or land use releases the carbon stored in the forests and reduces carbon sequestration potential of the land. The rate of forest conversion could be reduced by establishing protected areas for biological diversity and other conservation goals. The purpose of this study is to quantify the efficiency and potential of forest land protection for mitigating GHG emissions. Results: The analysis of related national-level datasets shows that during the period of 1992-2001 net forest losses in protected areas were small as compared to those in unprotected areas: -0.74% and -4.07%, respectively. If forest loss rates in protected and unprotected area had been similar, then forest losses in the protected forestlands would be larger by 870 km^2 /yr forests, that corresponds to release of 7 Tg C/yr (1 Tg=10^{12} g). Conversely, and continuing to assume no leakage effects or interactions of prices and harvest levels, about 1,200 km^2 /yr forests could have remained forest during the period of 1992-2001 if net area loss rate in the forestland outside protected areas was reduced by 20%. Not counting carbon in harvested wood products, this is equivalent to reducing fossil-fuel based carbon emissions by 10 Tg C/yr during this period. The South and West had much higher potentials to mitigate GHG emission from reducing loss rates in unprotected forests than that of North region. Spatially, rates of forest loss were higher across the coastal states in the southeastern US than would be expected from their population change, while interior states in the northern US experienced less forest area loss than would have been expected given their demographic characteristics. Conclusions: The estimated carbon benefit from the reduced forest loss based on current protected areas is 7 Tg C/yr, equivalent to the average carbon benefit per year for a previously proposed ten-year $110 million per year tree planting program scenario in the US. If there had been a program that could have reduced forest area loss by 20% in unprotected forestlands during 1992-2001, collectively the benefits from reduced forest loss would be equal to 9.4% of current net forest ecosystem carbon sequestration in the conterminous US.

Family forest owners and climate change: understanding, attitudes, and educational needs

Grotta, A. T.; Creighton, J. H.; Schnepf, C.; Kantor, S
Journal of Forestry; 2013. 111: 2, 87-93

Twenty-four focus groups were held throughout the Pacific Northwest to assess family forest owners' perceptions, understanding, and educational needs related to climate change and its potential impacts on family-owned forests. Participants cited many information sources and often referenced personal observations and connections. Perceptions of climate science were mixed, but skepticism was common, particularly regarding the extent to which research is driven by politics, money, or ideology. Participants were uncertain about possible climate change impacts but expressed concern about both biophysical and sociopolitical dimensions. Most participants did not expect to make significant changes to their management in anticipation of climate change. However, many participants wanted to learn more about climate change and how it might affect their forests. Results of these focus groups should provide insights for integrating climate science into extension programming in a variety of contexts, and suggestions for future extension programming are presented.

Where is the carbon? Carbon sequestration potential from private forestland in the southern United States

Galik, C. S.; Murray, B. C.; Mercer, D. E
Journal of Forestry; 2013. 111: 1, 17-25.

Uncertainty surrounding the future supply of timber in the southern United States prompted the question, "Where is all the wood?" (Cubbage et al. 1995). We ask a similar question about the potential of southern forests to mitigate greenhouse gas (GHG) emissions by sequestering carbon. Because significant carbon sequestration potential occurs on individual nonindustrial private forest (NIPF) lands owned by individuals, the accuracy of projections depends on how NIPF landowners respond to prices and their ability and willingness to

participate in carbon offset programs. Striving to produce a more realistic assessment of the potential for southern forests to sequester carbon in response to future markets or policies, we use National Woodland Owner Survey data from the Forest Inventory and Analysis program to link landowner demographic and behavioral data with forest conditions. We also examine barriers to NIPF participation in carbon offset programs and offer recommendations for overcoming those barriers

Opportunities and challenges for integrating bioenergy into sustainable forest management certification programs

Gan JianBang; Cashore, B.;

Journal of Forestry; 2013. 111: 1, 11-16

We review certification programs targeting sustainable bioenergy production and identify common features and differences with sustainable forest management (SFM) certification programs. SFM programs are compatible with bioenergy certification programs except for greenhouse gas (GHG) emissions, air quality, and food security requirements. Program commonalities call for coupling SFM and bioenergy certification to reduce costs and enhance program development and adoption. As integrated biorefineries using wood-based feedstocks come online, the coupling of certification programs seems inevitable and beneficial. In turn, bioenergy certification may improve forest management and operations as well as energy and land-use efficiencies. Coupled certification will thus help find the balance between biomass removals and long-term soil productivity on the one hand and sequestration of carbon in forest growing stock and wood-based products with bioenergy GHG emission offsets on the other.

A novel application of satellite radar data: measuring carbon sequestration and detecting degradation in a community forestry project in Mozambique

Mitchard, E. T. A.; Meir, P.; Ryan, C. M.; Woollen, E. S.; Williams, M.; Goodman, L. E.; Mucavele, J. A.; Watts, P.; Woodhouse, I. H.; Saatchi, S. S.

Plant Ecology & Diversity; 2013. 6: 1, 159-170

Background: It is essential that systems for measuring changes in carbon stocks for Reducing Emissions from Deforestation and Forest Degradation (REDD) projects are accurate, reliable and low cost. Widely used systems involving classifying optical satellite data can underestimate degradation, and by classifying the landscape ignore the natural heterogeneity of biomass. Aims: To assess the ability of repeat L-band radar to detect areas of small increases or decreases in above-ground biomass (AGB) across a Miombo woodland landscape. Methods: ALOS PALSAR L-band crosspolarised (HV) radar data from 2007 and 2009 were used to create maps of AGB, calibrated using 58 field plots. The change in AGB was assessed for land parcels with known landcover histories: (i) 500 ha of new agroforestry; (ii) 9500 ha of protected (REDD) areas; and (iii) 23 ha of land where degradation occurred between 2007 and 2009. Results: Increases in AGB were detected in both the agroforestry and REDD areas (0.4 and 1.1 Mg C ha^{-1} $year^{-1}$, respectively), while the degraded areas showed a decrease of 3 Mg C ha^{-1} $year^{-1}$. Conclusions: PALSAR data can be used to detect losses and gains in AGB in woodland ecosystems. However, further work is needed to precisely quantify the uncertainties in the change estimates, and the extent of false-positive and false-negative change detections that would result from using such a system.

Thinning effects on forest productivity: consequences of preserving old forests and mitigating impacts of fire and drought

Law, B. E.; Hudiburg, T. W.; Luyssaert, S

Plant Ecology & Diversity; 2013. 6: 1, 73-85

Background: Management strategies have been proposed to minimise the effects of climate change on forest resilience. Aims: We investigated the Pacific Northwest US region forest carbon balance under current practices, and changes that may result from management practices proposed for the region's 34 million ha of forests to mitigate climate change effects. Methods: We examined the relationship between net primary production (NPP) and biomass, using plot data, and estimated the effects of proposed clear-cut harvest of young mesic forests for wood products and bioenergy while preserving mesic mature/old forests for biodiversity (Sparing), thinning all forests (Sharing) and a combination of sparing mesic mature and old, clearing mesic young and thinning dry forests (Sparing/Sharing). Results: The forests of the region were found highly productive (NPP 163 Tg C $year^{-1}$) and a strong carbon sink with net ecosystem production of 45 Tg C $year^{-1}$. Observations indicated the relationship between NPP and biomass was not significantly different for thinned versus unthinned stands, after accounting for site quality and precipitation effects. After simulating proposed management to mitigate climate change, regional NPP was reduced by 35% (Sparing), 9% (Sharing) and 29% (Sparing/Sharing) compared with current practices. Conclusions: Applying management practices appropriate for current forest conditions to mitigate future climate change impacts can be accomplished, but at a cost of reducing NPP. Sparing all forests >50 years old resulted in the largest NPP reduction, but the impact could be

reduced by clearing only a subset of young forests.

Water use of young maritime pine and *Eucalyptus* stands in response to climatic drying in south-western France

Moreaux, V.; O'Grady, A. P.; Nguyen-The, N.; Loustau, D.;

Plant Ecology & Diversity; 2013. 6: 1, 57-71.

Background: There is increasing interest in developing eucalypt stands in France for biomass energy, but the water requirements of eucalypt coppice are largely unknown. Aims: We assessed the water use and growth of two 5-year-old managed forest stands: an indigenous maritime pine stand and an introduced eucalypt stand. Methods: We used a combination of meteorological, sap flow, soil and biomass measurements, between September 2009 and July 2011. Results: The stand structure was the main driver of both water use and its partitioning between water balance components in each site. The evapotranspiration was high in the eucalypt stand, with a significant contribution of tree transpiration due to high leaf area index of the tree canopy. Under well-watered conditions, both species exhibited a similar stomatal behaviour in relation to vapour pressure deficit and, with high biomass production, the two stands presented a maximal water use efficiency in respect to their local environments and constraints. However, they experienced significant sensitivity to successive early spring and summer droughts. The unexpected prolonged soil water deficit in the eucalypt stand, induced by high water consumption and insufficient water supply, directly impacted leaf shedding and stem secondary growth. In contrast, the pines appeared conservative with respect to soil water deficits and maintained secondary growth.

Temperature as a potent driver of regional forest drought stress and tree mortality

Williams, A. P.; Allen, C. D.; MacAlady, A. K.; Griffin, D.; Woodhouse, C. A.; Meko, D. M.; Swetnam, T. W.; Rauscher, S. A.; Seager, R.; Grissino-Mayer, H. D.; Dean, J. S.; Cook, E. R.;

Gangodagamage, C.; Cai, M.; McDowell, N. G.;

Nature Climate Change; 2013. 3: 3, 292-297

As the climate changes, drought may reduce tree productivity and survival across many forest ecosystems; however, the relative influence of specific climate parameters on forest decline is poorly understood. We derive a forest drought-stress index (FDSI) for the southwestern United States using a comprehensive tree-ring data set representing AD 1000-2007. The FDSI is approximately equally influenced by the warm-season vapour-pressure deficit (largely controlled by temperature) and cold-season precipitation, together explaining 82% of the FDSI variability. Correspondence between the FDSI and measures of forest productivity, mortality, bark-beetle outbreak and wildfire validate the FDSI as a holistic forest-vigour indicator. If the vapour-pressure deficit continues increasing as projected by climate models, the mean forest drought-stress by the 2050s will exceed that of the most severe droughts in the past 1,000 years. Collectively, the results foreshadow twenty-first-century changes in forest structures and compositions, with transition of forests in the southwestern United States, and perhaps water-limited forests globally, towards distributions unfamiliar to modern civilization.

Water-quality impacts from climate-induced forest die-off

Mikkelson, K. M.; Dickenson, E. R. V.; Maxwell, R. M.; McCray, J. E.; Sharp, J. O.

Nature Climate Change; 2013. 3: 3, 218-222

Increased ecosystem susceptibility to pests and other stressors has been attributed to climate change, resulting in unprecedented tree mortality from insect infestations. In turn, large-scale tree die-off alters physical and biogeochemical processes, such as organic matter decay and hydrologic flow paths that could enhance leaching of natural organic matter to soil and surface waters and increase potential formation of harmful drinking water disinfection by-products (DBPs). Whereas previous studies have investigated water-quantity alterations due to climate-induced, forest die-off, impacts on water quality are unclear. Here, water-quality data sets from water-treatment facilities in Colorado were analysed to determine whether the municipal water supply has been perturbed by tree mortality. Results demonstrate higher total organic carbon concentrations along with significantly more DBPs at water-treatment facilities using mountain-pine-beetle-infested source waters when contrasted with those using water from control watersheds. In addition to this differentiation between watersheds, DBP concentrations demonstrated an increase within mountain pine beetle watersheds related to the degree of infestation. Disproportionate DBP increases and seasonal decoupling of peak DBP and total organic carbon concentrations further suggest that the total organic carbon composition is being altered in these systems.

Quantifying variation in forest disturbance, and its effects on aboveground biomass dynamics, across the eastern United States

Vanderwel, M. C.; Coomes, D. A.; Purves, D. W.

Global Change Biology; 2013. 19: 5, 1504-1517

The role of tree mortality in the global carbon balance is complicated by strong spatial and temporal heterogeneity that arises from the stochastic nature of carbon loss through disturbance. Characterizing spatio-temporal variation in mortality (including disturbance) and its effects on forest and carbon dynamics is thus essential to understanding the current global forest carbon sink, and to predicting how it will change in future. We analyzed forest inventory data from the eastern United States to estimate plot-level variation in mortality (relative to a long-term background rate for individual trees) for nine distinct forest regions. Disturbances that produced at least a fourfold increase in tree mortality over an approximately 5 year interval were observed in 1-5% of plots in each forest region. The frequency of disturbance was lowest in the northeast, and increased southwards along the Atlantic and Gulf coasts as fire and hurricane disturbances became progressively more common. Across the central and northern parts of the region, natural disturbances appeared to reflect a diffuse combination of wind, insects, disease, and ice storms. By linking estimated covariation in tree growth and mortality over time with a data-constrained forest dynamics model, we simulated the implications of stochastic variation in mortality for long-term aboveground biomass changes across the eastern United States. A geographic gradient in disturbance frequency induced notable differences in biomass dynamics between the least- and most-disturbed regions, with variation in mortality causing the latter to undergo considerably stronger fluctuations in aboveground stand biomass over time. Moreover, regional simulations showed that a given long-term increase in mean mortality rates would support greater aboveground biomass when expressed through disturbance effects compared with background mortality, particularly for early-successional species. The effects of increased tree mortality on carbon stocks and forest composition may thus depend partly on whether future mortality increases are chronic or episodic in nature.

Winter climate change and coastal wetland foundation species: salt marshes vs. mangrove forests in the southeastern United States.

Osland, M. J.; Enwright, N.; Day, R. H.; Doyle, T. W.

Global Change Biology; 2013. 19: 5, 1482-1494

We live in an era of unprecedented ecological change in which ecologists and natural resource managers are increasingly challenged to anticipate and prepare for the ecological effects of future global change. In this study, we investigated the potential effect of winter climate change upon salt marsh and mangrove forest foundation species in the southeastern United States. Our research addresses the following three questions: (1) What is the relationship between winter climate and the presence and abundance of mangrove forests relative to salt marshes; (2) How vulnerable are salt marshes to winter climate change-induced mangrove forest range expansion; and (3) What is the potential future distribution and relative abundance of mangrove forests under alternative winter climate change scenarios? We developed simple winter climate-based models to predict mangrove forest distribution and relative abundance using observed winter temperature data (1970-2000) and mangrove forest and salt marsh habitat data. Our results identify winter climate thresholds for salt marsh-mangrove forest interactions and highlight coastal areas in the southeastern United States (e.g., Texas, Louisiana, and parts of Florida) where relatively small changes in the intensity and frequency of extreme winter events could cause relatively dramatic landscape-scale ecosystem structural and functional change in the form of poleward mangrove forest migration and salt marsh displacement. The ecological implications of these marsh-to-mangrove forest conversions are poorly understood, but would likely include changes for associated fish and wildlife populations and for the supply of some ecosystem goods and services.

Plant-soil interactions in Mediterranean forest and shrublands: impacts of climatic change

Sardans, J.; Penuelas, J.

Plant and Soil; 2013. 365: 1/2, 1-33.

Background: In the Mediterranean climate, plants have evolved under conditions of low soil-water and nutrient availabilities and have acquired a series of adaptive traits that, in turn exert strong feedback on soil fertility, structure, and protection. As a result, plant-soil systems constitute complex interactive webs where these adaptive traits allow plants to maximize the use of scarce resources. Scope: It is necessary to review the current bibliography to highlight the most know characteristic mechanisms underlying Mediterranean plant-soil feed-backs and identify the processes that merit further research in order to reach an understanding of the plant-soil feed-backs and its capacity to cope with future global change scenarios. In this review, we characterize the functional and structural plant-soil relationships and feedbacks in Mediterranean regions. We thereafter discuss the effects of global change drivers on these complex interactions between plants and soil. Conclusions: The large plant diversity that characterizes Mediterranean ecosystems is associated to the success of coexisting species in avoiding competition for soil resources by differential exploitation in space (soil layers) and time (year and daily). Among plant and soil traits, high foliar nutrient re-translocation and large contents

of recalcitrant compounds reduce nutrient cycling. Meanwhile increased allocation of resources to roots and soil enzymes help to protect against soil erosion and to improve soil fertility and capacity to retain water. The long-term evolutionary adaptation to drought of Mediterranean plants allows them to cope with moderate increases of drought without significant losses of production and survival in some species. However, other species have proved to be more sensitive decreasing their growth and increasing their mortality under moderate rising of drought. All these increases contribute to species composition shifts. Moreover, in more xeric sites, the desertification resulting from synergic interactions among some related process such as drought increases, torrential rainfall increases and human driven disturbances is an increasing concern. A research priority now is to discern the effects of long-term increases in atmospheric CO_2 concentrations, warming, and drought on soil fertility and water availability and on the structure of soil communities (e.g., shifts from bacteria to fungi) and on patching vegetation and root-water uplift (from soil to plant and from soil deep layers to soil superficial layers) roles in desertification.

Empirical analysis of the influence of forest extent on annual and seasonal surface temperatures for the continental United States

Wickham, J. D.; Wade, T. G.; Riitters, K. H.;

Global Ecology and Biogeography; 2013. 22: 5, 620-629.

Aim: Because of the low albedo of forests and other biophysical factors, most scenario-based climate modelling studies indicate that removal of temperate forest will promote cooling, indicating that temperate forests are a source of heat relative to other classes of land cover. Our objective was to test the hypothesis that US temperate forests reduce surface temperatures. Location: The continental United States. Methods: Ordinary least squares regression was used to develop relationships between forest extent and surface temperature. Forest extent was derived from the 900m² 2001 National Land Cover Database (NLCD 2001) and surface temperature data were from the MODIS 1 km² 8-day composite (MYD11A2). Forest-surface temperature relationships were developed for winter, spring, summer, autumn and annually using 5 years of MODIS land surface temperature data (2007-11) across six spatial scales (1, 4, 9, 16, 25 and 36 km²). Regression models controlled for the effects of elevation, aspect and latitude (by constraining the regressions within a 1 degrees range). Results: We did not find any significant positive slopes in regressions of average annual surface temperatures versus the proportion of forest, indicating that forests are not a source of heat relative to other types of land cover. We fund that surface temperatures declined as the proportion of forest increased for spring, summer, autumn and annually. The forest-surface temperature relationship was also scale dependent in that spatially extensive forests produced cooler surface temperatures than forests that were dominant only locally. Main conclusions: Our results are not consistent with most scenariobased climate modelling studies. Because of their warming potential, the value of temperate afforestation as a potential climate change mitigation strategy is unclear. Our results indicate that temperate afforestation is a climate change mitigation strategy that should be implemented to promote spatially extensive forests.

Warming climates, changing forests: temperature tolerances of trees and carbon dynamics in Northeastern temperate forests

Patterson, A. E.

Consilience: The Journal of Sustainable Development; 2013. 9, 160-171

Extensive botanical surveys and long term plots have shown that since the early 1930's, Black Rock Forest, located in the Hudson Highlands of New York, three tree species were extirpated and seven were gained. These results are consistent with a warming climate and suggest the Hudson River Valley may be an important location to study the effects of climate change on Northeastern forests. Classic global vegetation and species distribution models primarily use species presence/absence or presence only distribution with preferred environmental parameters to predict range distributions of plant communities under increasing CO₂ regimes, and thus climate warming. Although these models have begun to incorporate physiological data (photosynthesis, stomatal response, and respiration), they lack a sophisticated parameterization of species-specific physiological characteristics and complex interactions within plant communities. More experimentation is necessary to validate assumptions regarding the mechanisms behind tree species responses to climate change and narrow the variability of model outputs. During the summer of 2012, I explored the physiological mechanisms for species tolerance to increasing temperatures and considered the potential effects on the carbon storage capacity of forest trees under the predicted warmer climates of the coming century.

National governance structures for REDD+.

Vatn, A.; Vedeld, P. O.;

Global Environmental Change; 2013. 23: 2, 422-432.

This paper analyses a set of generic options for national REDD+ governance structures - i.e., (a) a market/project based architecture; (b) a system with national REDD+ funds outside existing national administrations; (c) a national REDD+ fund organized under the present administration; and (d) conditional budget support. The analysis is based on experiences from different, but similar governance structures - e.g., the Clean Development Mechanism, payments for ecosystem services, environmental trust funds and various forms of budget support. While a solution with a market/project based structure has been favored by many, we conclude that this is the most problematic alternative. Concerning the other three, the national/local conditions will be of importance for their functioning. If REDD+ policies involve a large part of a county's forested area, establishing a good link to the general forest and other sector policies will be necessary

Opportunities and challenges to capturing the multiple potential benefits of REDD+ in a traditional transnational savanna-woodland region in West Africa.

Olsson, E. G. A.; Ouattara, S.

Ambio; 2013. 42: 3, 309-319

The REDD+ scheme of the United Nations intends to offer developing countries financial incentives to reduce the rates of deforestation and forest degradation for reducing global CO_2 emissions. This is combined with building carbon stocks in existing wooded ecosystems and fostering other soil, biodiversity and water conservation objectives. Successful application of REDD+ to the Xylophone Triangle of West Africa faces substantial challenges and risks to both meeting REDD+ objectives and to the local people's rights and livelihoods. The transnationality of the culturally coherent area requires collaboration of three national governments. The opportunities, however, are great to capitalize on the region's biodiversity, the well-developed traditional ecological knowledge and the use of local medicinal plants as an integral part of the agro-ecosystem. Possibilities open to, not only sequester carbon, but also to increase the resilience of the ecosystem and of independent rural livelihoods in the face of climate change and globalization.

Demand and proximity: drivers of illegal forest resource extraction

Mackenzie, C. A.; Hartter, J.

Oryx; 2013. 47: 2, 288-297.

Illegal extraction from protected areas is often shaped by the surrounding socio-economic landscape. We coupled village-scale socio-economic parameters collected using household surveys with measured levels of illegal resource extraction proximate to study villages to investigate the socio-economic drivers of illegal extraction from Kibale National Park, Uganda. The level of illegal tree harvesting and the number of illegal entry trails into the Park were driven by subsistence demand from villages adjacent to the Park and by for-profit extraction to supply local urban markets, whereas grazing in the Park was linked to high livestock ownership. Capital asset wealth, excluding livestock, was found to mitigate illegal resource extraction from the Park. We also found high human population density to coincide spatially with park-based tourism, research and carbon sequestration employment opportunities. Conservation strategies should be integrated with national policy to meet the needs of local communities and to manage urban demand to reduce illegal extraction from protected areas.

Simulated resilience of tropical rainforests to CO_2 induced climate change

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Nature Geoscience; 2013. 6: 4, 268-273

How tropical forest carbon stocks might alter in response to changes in climate and atmospheric composition is uncertain. However, assessing potential future carbon loss from tropical forests is important for evaluating the efficacy of programmes for reducing emissions from deforestation and degradation. Uncertainties are associated with different carbon stock responses in models with different representations of vegetation processes on the one hand, and differences in projected changes in temperature and precipitation patterns on the other hand. Here we present a systematic exploration of these sources of uncertainty, along with uncertainty arising from different emissions scenarios for all three main tropical forest regions: the Americas (that is, Amazonia and Central America), Africa and Asia. Using simulations with 22 climate models and the MOSES-TRIFFID land surface scheme, we find that only in one of the simulations are tropical forests projected to lose biomass by the end of the twenty-first century-and then only for the Americas. When comparing with alternative models of plant physiological processes, we find that the largest uncertainties are associated with plant physiological responses, and then with future emissions scenarios. Uncertainties from differences in the climate projections are significantly smaller. Despite the considerable uncertainties, we conclude that there is evidence of forest resilience for all three regions.

Environmental change impacts on the C- and N-cycle of European forests: a model comparison study

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Biogeosciences; 2013. 10: 3, 1751-1773

Forests are important components of the greenhouse gas balance of Europe. There is considerable uncertainty about how predicted changes to climate and nitrogen deposition will perturb the carbon and nitrogen cycles of European forests and thereby alter forest growth, carbon sequestration and N_2O emission. The present study aimed to quantify the carbon and nitrogen balance, including the exchange of greenhouse gases, of European forests over the period 2010–2030, with a particular emphasis on the spatial variability of change. The analysis was carried out for two tree species: European beech and Scots pine. For this purpose, four different dynamic models were used: BASFOR, DailyDayCent, INTEGRATOR and Landscape-DNDC. These models span a range from semi-empirical to complex mechanistic. Comparison of these models allowed assessment of the extent to which model predictions depended on differences in model inputs and structure. We found a European average carbon sink of 0.160 ± 0.020 kgC m−2 yr−1 (pine) and 0.138 ± 0.062 kgC m−2 yr−1 (beech) and N_2O source of 0.285 ± 0.125 kgN ha−1 yr−1 (pine) and 0.575 ± 0.105 kgN ha−1 yr−1 (beech). The European average greenhouse gas potential of the carbon source was 18 (pine) and 8 (beech) times that of the N_2O source. Carbon sequestration was larger in the trees than in the soil. Carbon sequestration and forest growth were largest in central Europe and lowest in northern Sweden and Finland, N. Poland and S. Spain. No single driver was found to dominate change across Europe. Forests were found to be most sensitive to change in environmental drivers where the drivers were limiting growth, where changes were particularly large or where changes acted in concert. The models disagreed as to which environmental changes were most significant for the geographical variation in forest growth and as to which tree species showed the largest rate of carbon sequestration. Pine and beech forests were found to have differing sensitivities to environmental change, in particular the response to changes in nitrogen and precipitation, with beech forest more vulnerable to drought. There was considerable uncertainty about the geographical location of N_2O emissions. Two of the models BASFOR and LandscapeDNDC had largest emissions in central Europe where nitrogen deposition and soil nitrogen were largest whereas the two other models identified different regions with large N_2O emission. N_2O emissions were found to be larger from beech than pine forests and were found to be particularly sensitive to forest growth.

Assessment of multiple ecosystem services in New Zealand at the catchment scale

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Environmental Modelling & Software; 2013. 43: 37-48

The ecosystem services approach to resource management considers all services provided by ecosystems to all sections of the community. As such, it could be used to assess sustainability of human development and equity in resource use. To facilitate the approach, tools are required at the level of detail at which policy and management decisions are made. We have developed spatially explicit models of indicators of important ecosystem services in New Zealand: regulation of climate, control of soil erosion, regulation of water flow (quantity), provision of clean water (quality), provision of food and fibre, and provision of natural habitat. The models were developed using lookup tables from process-based models to allow rapid evaluation of land-use scenarios. We demonstrate the application of the models to assess ecosystem services in a simulation of hill-country afforestation in the Manawatu catchment, which has recently seen increasing soil erosion in the hills leading to sedimentation of waterways. Each ecosystem service was assessed by calculating the change in the indicator relative to two extremes. The ecosystem services with the largest relative changes were control of soil erosion, carbon sequestration, and provision of wood.

Modeling the impacts of climate variability and hurricane on carbon sequestration in a coastal forested wetland in South Carolina

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Natural Science; 2013. 5: 3, 375-388

The impacts of hurricane disturbance and climate variability on carbon dynamics in a coastal forested wetland in South Carolina of USA were simulated using the Forest-DNDC model with a spatially explicit approach. The model was validated using the measured biomass before and after Hurricane Hugo and the biomass inventories in 2006 and 2007, showed that the Forest-DNDC model was applicable for estimating carbon dynamics with hurricane disturbance. The simulated results indicated that Hurricane Hugo in 1989 substantially influenced carbon storage immediately after the disturbance event. The simulated net ecosystem exchange (NEE) for the 58-year period (1950-2007) indicated that the hurricane reduced CO_2 sequestration due primarily to the increased decomposition of a large amount of litter and woody debris, including fallen trees (over 80% of pre-hurricane trees), debris and branches, and dead roots. The inter-annual fluctuation of soil CO_2 flux showed that the climate variability interfered substantially soil carbon dynamics in the forest. The results showed that

there were substantial spatial and temporal differences in CO_2 flux (3.2-4.8 Mg.C.ha^{-1}) and wood biomass due to the differences in physical and biogeochemical characteristics in the forest.

Harnessing REDD+ opportunities for forest conservation and carbon stock enhancement in the Northeastern States of India

Murthy, I. K.; Nitasha Sharma; Nijavalli, H. R

Natural Science; 2013. 5: 3, 349-358.

Forests have significant economic and ecological value as a provider of ecosystem services, being home to much of the world's biodiversity and supporting the livelihoods of many people. Reducing emissions from deforestation and forest degradation in developing countries (REDD) is a critical component of the overall greenhouse gas emission reductions and now the significance of REDD+ (which is not only about reducing emissions but halting and reversing forest loss), in delivering climate change mitigation benefits along with co-benefits, is increasingly being recognized in global climate negotiations. Northeast India provides a tremendous potential for harnessing REDD+ activities with about 66% of the total geographical area of the region being covered by forests. This paper attempts to explore this potential besides estimating the area available for different options under REDD+ as well as the mitigation potential using COMAP model, overcoming limitations of existing studies or a lack of them. Within this, the status of forests and biodiversity along with drivers of deforestation in north east India are documented and an assessment of the potential for taking up reducing deforestation and degradation and enhancement of carbon stocks and afforestation is conducted both at the state as well as district level. It was found that northeastern states have been experiencing net forest loss during the last few years along with significant scale forest degradation, with Nagaland followed by Arunachal Pradesh offering maximum potential for "reducing deforestation" option under REDD and the total incremental annual mitigation potential of the four REDD+ activities in northeast India being 29.2 MtCO_2 for 2030.

Comparison of carbon sequestration potential in agricultural and afforestation farming systems

Lin ChinSu; Lin ChunHsiung

Scientia Agricola; 2013. 70: 2, 93-101

In the last few decades, many forests have been cut down to make room for cultivation and to increase food or energy crops production in developing countries. In this study, carbon sequestration and wood production were evaluated on afforested farms by integrating the Gaussian diameter distribution model and exponential diameter-height model derived from sample plots of an afforested hardwood forest in Taiwan. The quantity of sequestrated carbon was determined based on aboveground biomass. Through pilot tests run on an age-volume model, an estimation bias was obtained and used to correct predicted volume estimates for a farm forest over a 20-year period. An estimated carbon sequestration of 11,254 t C was observed for a 189 ha-hardwood forest which is equivalent to 41,264 t CO_2. If this amount of carbon dioxide were exchanged on the Chicago Climate Exchange (CCX) market, the income earned would be 821 US$ ha^{-1}. Carbon sequestration from rice (*Oryza sativa*) or sugarcane (*Saccharum officinarum*) production is discharged as a result of straw decomposition in the soil which also improves soil quality. Sugarcane production does not contribute significantly to carbon sequestration, because almost all the cane fiber is used as fuel for sugar mills. As a result of changing the farming systems to hardwood forest in this study area, carbon sequestration and carbon storage have increased at the rate of 2.98 t C ha^{-1} year^{-1}. Net present value of afforestation for a 20-year period of carbon or wood management is estimated at around US$ 30,000 given an annual base interest rate of 3%.

The contribution of managed and unmanaged forests to climate change mitigation - a model approach at stand level for the main tree species in Bavaria

Klein, D.; Hollerl, S.; Blaschke, M.; Schulz, C

Forests; 2013. 4: 1, 43-69

Forestry-based carbon sequestration projects demand a comprehensive quantification of the different climate change mitigation effects. In our study, we modeled a life cycle of managed pure stands consisting of the four main tree species in Bavaria (spruce, pine, beech and oak). For spruce and beech, an unmanaged stand was additionally integrated in order to analyze the differences in climate change mitigation effects compared to the managed stands. We developed a climate change mitigation model, where stand development and silvicultural treatments including harvested timber volumes were conducted using the tree growth model Silva 2.3. The harvested wood products (HWP), including their substitution effects were calculated with a subsequent model. For unmanaged beech forests, we compiled measured data from the literature, and Bavarian strict forest reserves for validating our model results. The results for the managed stands reveal that spruce provides the highest total climate change mitigation effects. After a simulation period of 180 years, one hectare leads to a mean mitigation benefit of 13.5 Mg CO_2 ha^{-1} year^{-1}. In comparison, results for pine, beech and oak reveal lesser benefits with 10.1 Mg CO_2 ha^{-1} year^{-1}, 9.1 Mg CO_2 ha^{-1} year^{-1} and 7.2 Mg CO_2 ha^{-1} year^{-1}, respectively. However, these results assume current growing conditions. Considering climate change, it is very

likely that spruce will not be suitable in several regions of Bavaria in the future. Furthermore, excessive disturbances could affect spruce more drastically than the other tree species. In that case, the order could change and beech could exceed spruce. Thus the results cannot be seen as a general recommendation to establish spruce stands in order to achieve optimal climate change mitigation benefits. Nevertheless, results for spruce illustrate that high increment and especially wood use in long-lived products is crucial for high climate change mitigation effects. Mitigation effects in unmanaged spruce and beech stands do not differ in the first decades from their managed counterparts, but are below them in the long term with a total climate change mitigation benefit of 8.0 Mg CO_2 ha^{-1} $year^{-1}$ and 7.2 Mg CO_2 ha^{-1} $year^{-1}$, respectively. These differences are mainly caused by the missing substitution effects in the unmanaged stands. However, the precise dimensions of substitution effects still remain uncertain and the lack of data should be reduced via additional life cycle assessments for more products and product classes. However, neglecting substitution effects in climate change mitigation models leads to severe underestimations of the mitigation effects in managed forests.

Measuring environmental change in forest ecosystems by repeated soil sampling: a North American perspective

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Journal of Environmental Quality; 2013. 42: 3, 623-639.

Environmental change is monitored in North America through repeated measurements of weather, stream and river flow, air and water quality, and most recently, soil properties. Some scepticism remains, however, about whether repeated soil sampling can effectively distinguish between temporal and spatial variability, and efforts to document soil change in forest ecosystems through repeated measurements are largely nascent and uncoordinated. In eastern North America, repeated soil sampling has begun to provide valuable information on environmental problems such as air pollution. This review synthesizes the current state of the science to further the development and use of soil resampling as an integral method for recording and understanding environmental change in forested settings. The origins of soil resampling reach back to the 19th century in England and Russia. The concepts and methodologies involved in forest soil resampling are reviewed and evaluated through a discussion of how temporal and spatial variability can be addressed with a variety of sampling approaches. Key resampling studies demonstrate the type of results that can be obtained through differing approaches. Ongoing, large-scale issues such as recovery from acidification, long-term N deposition, C sequestration, effects of climate change, impacts from invasive species, and the increasing intensification of soil management all warrant the use of soil resampling as an essential tool for environmental monitoring and assessment. Furthermore, with better awareness of the value of soil resampling, studies can be designed with a long-term perspective so that information can be efficiently obtained well into the future to address problems that have not yet surfaced.

Property rights and climate change vulnerability in Turkish forest communities: a case study from Seyhan River Basin, Turkey

Chan, C.

Climate and Development; 2013. 5: 1, 1-13

Turkey is expected to experience significant climate change, including increased temperatures and desertification. As these changes affect forestry, agriculture and animal husbandry, they threaten the livelihoods of forest communities across the country. In addition, other, institutional factors such as the property regime can act in tandem with physical stressors to increase communities' overall vulnerability to climate change. This article focuses on how the current structure of Turkish forest property rights, in determining access to forest resources that communities depend on for building resilience in marginal environments, influences communities' adaption strategies and shapes their vulnerability to climate change. Through an analysis of how forest communities in the Seyhan River Basin gain access to state-owned forest resources, this article shows that without secure access to these resources, forest communities in the Basin are made more vulnerable to the impacts of climate change.

Biofuels and climate change mitigation: a CGE analysis incorporating land-use change

Timilsina, G. R.; Mevel, S

Environmental and Resource Economics; 2013. 55: 1, 1-19

The question of whether or not biofuels help mitigate climate change has attracted much debate in the literature. Using a global computable general equilibrium model that explicitly represents landuse change impacts due to the expansion of biofuels, our study attempts to shed some light on this question. Our study shows that if biofuel mandates and targets currently announced by more than 40 countries around the world are implemented by 2020 using crop feedstocks and if both forests and pasture lands are used to meet the new land demands for biofuel expansion, this would cause net release of GHG emissions to the atmosphere until

2043 as the GHG emissions released through land-use change exceeds the reduction of emissions due to replacement of gasoline and diesel. On the other hand, if the use of forest lands is avoided by channeling only pasture lands to meet the demand for new lands, the net release of GHG emissions would cease by 2021, a year after the full implementation of the mandates and targets.

Implementing conservativeness in REDD+ is realistic and useful to address the most uncertain estimates

Grassi, G., Federici, S., Arhard, F.

Climatic Change. DOI 10.1007/s10584-013-0780-x

One of the main challenges in reducing emissions from deforestation and forest degradation (REDD+), either within a future UNFCCC approach or as part of other voluntary initiatives, is to design a system which is credible and broadly implementable by developing countries. To ensure credibility of REDD+ high quality monitoring systems are needed, i.e. capable of producing accurate estimates of greenhouse gas (GHG) emissions and removals. However, a possible trade-off exists between the high quality system requirement and broad participation: if a significant number of countries will not fully access REDD+ because of not being able to produce accurate estimates, the consequent risk of leakage (i.e. emissions displacement to these countries) could undermine the ultimate scope of REDD+. Plugge et al. (2012) analyzed the implications of applying the principle of conservativeness in the context of uncertainties of carbon stock change estimates in REDD+. While this principle is included in several UNFCCC documents (e.g., UNFCCC 2006), its application to REDD+ was proposed by Grassi et al. (2008) "to address the potential incompleteness and high uncertainties of REDD+ estimates"; i.e. "when completeness or accuracy of estimates cannot be achieved the reduction of emissions should not be overestimated, or at least the risk of overestimation should be reduced".Wide interest has been shown in this proposal (e.g., GOFC-GOLD 2012; Herold & Skutsch 2011; Meridian Institute 2011). A key message from Plugge et al. (2012) is that, despite its attractiveness, the conservativeness principle does not appear to be implementable in many cases, because it drastically reduces the amount of emission reductions that can be claimed (e.g. "for countries with low deforestation rates REDD is obviously not an option for generating benefits, as they would need to implement monitoring systems that are able to estimate carbon stock changes with a total error well below 1 %"). Similar conclusions, using a similar approach, were also presented in Köhl et al. (2009). We believe that this conclusion: on the impossibility for countries with low deforestation rates to generate REDD+ benefits under a conservative approach, is the consequence of the assumptions taken by these authors. In particular, some elements appear to have been overlooked by Plugge et al. (2012). Firstly, one of the underlying basic ideas beyond REDD+ is to incentivize actions (i.e. emission reductions) beyond "business-as-usual". According to this approach, future net emissions from REDD+ should be compared against an agreed "baseline",1 which typically describes the expected business-as-usual net emissions. While in many cases it can be expected that this baseline will be equal to or lower than historical emission levels, in some cases (i.e. countries with low historical deforestation rates) the baseline could potentially include the expectation of increased emissions as compared to the past. Baseline-like concepts have been discussed both within UNFCCC (i.e. "reference levels", RL, and "reference emissions levels", REL) (UNFCCC 2012) and within several REDD+ initiatives. Thus, the possibility of countries with low deforestation rates to generate REDD+ benefits will largely depend on the criteria used to set their baselines. Secondly, Plugge et al. did not consider other and potentially more effective approaches to implement the conservativeness principle in REDD+ (e.g. Grassi et al. 2008). Even more importantly, some very simple conservative approaches have already been implemented by REDD+ initiatives, such as the Amazon fund,2 demonstrating the feasibility and the utility of this principle.

This comment aims to:

- Highlight the technical and scientific differences between the approaches of Plugge et al. (2012) and Grassi et al. (2008) for the implementation of the conservativeness principle.
- Summarize and further discuss a scientifically defensible

Community Participation and Benefits in REDD+: A Review of Initial Outcomes and Lessons

Lawlor, K., Madeira, E.M., Blockhus, J., Ganz, D.J.

Forests 2013, 4(2), 296-318

The advent of initiatives to reduce emissions from deforestation and degradation and enhance forest carbon stocks (REDD+) in developing countries has raised much concern regarding impacts on local communities. To inform this debate, we analyze the initial outcomes of those REDD+ projects that systematically report on their socio-economic dimensions. To categorize and compare projects, we develop a participation and benefits framework that considers REDD+'s effects on local populations' opportunities (jobs, income), security (of tenure and ecosystem services), and empowerment (participation in land use and development decisions). We find material benefits, in terms of jobs and income, to be, thus far, modest. On the other hand, we find that many projects are helping populations gain tenure rights. A majority of projects are obtaining local populations' free, prior, and informed consent (FPIC). However, for those projects interacting with multiple populations, extent of participation and effects on forest access are often uneven. Our participation and

benefits framework can be a useful tool for identifying the multi-faceted socio-economic impacts of REDD+, which are realized under different timescales. The framework and initial trends reported here can be used to build hypotheses for future REDD+ impact evaluations and contribute to evolving theories of incentive-based environmental policy.

V. PUBLICATIONS, REPORTS AND OTHER MEDIA

Climate change in European forests: how to adapt

EFI

This publication discusses different types of adaptive management for climate change based on research carried out in Europe (such as in boreal forests in Finland and Mediterranean forests in Spain) as part of the Models for Adaptive Forest Management project, a large-scale integrated project in the 7th Framework Programme of the European Union. Recommendations to further improve forest management systems in response to catastrophes intensified by climate change, such as wide-scale forest fires, are presented. **The policy brief**

Community Controlled Forests, Carbon Sequestration and REDD+: Some Evidence from Ethiopia

Resources for the Future

REDD+ (Reduced Emissions from Deforestation and Forest Degradation, "plus" afforestration) is a tool that supports forest carbon-enhancing approaches in the developing world in order to mitigate and hopefully reverse climate change. A key issue within REDD+ is to appropriately bring in the almost 25% of developing country forests that are effectively controlled by communities. Many authors have discussed the social aspects of appropriateness, but there is limited analysis of the actual carbon sequestration potential of better-managed community controlled forests (CCFs). Drawing on an analytical framework that relies heavily on the common property and social capital literatures, our paper contributes to closing this research gap and sheds light on whether community forest management structures should be given serious consideration as REDD+ partners in the battle to mitigate climate change. Using household and community level data from four regional states in Ethiopia, we examine whether CCFs with design features known to be associated with better management appear to sequester more carbon than community systems with lower levels of these characteristics. The empirical analysis suggests that the quality of local level institutions may be important determinants of carbon sequestration. Developing country CCFs may therefore play a positive role within the context of REDD+ and other carbon sequestration initiatives. However, because of the nature of our data, results should be considered indicative. Better and smarter data combined with innovative techniques are needed to conclusively evaluate linkages between CCFs, carbon sequestration and REDD+. **The paper**

Carbon rights legislation: not yet ready for private sector REDD+

IIED

REDD+ is already developing private sector engagements, making rights to sell and benefit from reduced emissions (carbon rights) a crucial issue. Our review of private sector REDD+ projects reveals tendencies for legal arrangements that reinterpret tenure law so as to bundle the new commodity of carbon regulation with existing rights to tangible resources. Provisions for benefit sharing, particularly those aimed at addressing the underlying causes of forest degradation, are often vague or missing. Given the size and duration of private REDD projects, this has far reaching and long term implications for communities and countries. **The briefing**

The contribution of European forest-related policies to climate change mitigation: Energy substitution first

CDC Climat Research

In a framework where no common forestry policy exists at the EU level (such as the Common Agriculture Policy for agriculture), this report lists EU policies that have an impact on climate change mitigation that can be achieved by the forestry sector. With the objective of analyzing the coherence of these policies, we have established a typology and a hierarchy firstly by laying out the legal status and the financial and institutional resources associated with each policy, and secondly by reviewing the objectives of each policy in regards to climate change mitigation in the forestry sector. We finally analyze potentials synergies and conflicts between them. The consequences of each policy on climate change mitigation is assessed through three principal mitigation pathways in the forestry sector: carbon sequestration in forests, energy substitution (biomass, etc.), and what we refer to as the "harvested wood product use effect" (the sequestration of carbon in wood products and the substitution of more carbon-intensive materials with wood). The forest-related EU policies analyzed in this report are found to be globally coherent in terms of shared objectives, defining an EU forestry

mitigation strategy focused on energy substitution through:

• the Climate and Energy Package that does not address exclusively the forestry sector but has significant influence on energy substitution;

• the European Agriculture Fund for Rural Development (EAFRD), the most important fund concerning forestry. Among the eligible actions which touch upon climate and forestry, member states have favoured those supporting energy-substitution and to a lesser extent carbon sequestration in forests;

Non-mandatory policies such as forest strategies and the forest action plan have diversified objectives touching upon the three mitigation pathways. However their non-legally binding nature brings us to play down their importance. In the end, despite the unbalanced attention given to the different mitigation options, policy objectives are nevertheless coordinated and often complementary in terms of climate change mitigation. **The report**

REDD+ Demands a Rigorous Carbon Accounting Process to Enable Project Investment and Sale of its Credits – A Summary of the VCS Steps

CINCS

This brief article highlights the technical process that a REDD project must go through to be eligible to attract project-land investment and sell its offsets on the voluntary market. A compliance market for these offset types does not yet exist. **The article**

Land tenure and fast-tracking REDD+: time to reframe the debate?

Global Canopy Programme

The authors of this Analytical Paper argue that policy makers in forest countries must look beyond reform of tenure laws to address the pressing need for REDD+ enabling conditions. A global agreement on REDD+ is needed by 2020 if the mechanism is to have a significant impact on mitigating climate change. However, legally defensible and enforceable land tenure rights, while a key enabling condition for effective and equitable REDD+, will not be achieved in most forest countries before this date. In addition, by drawing on examples from Nepal and Papua New Guinea, the authors demonstrate that limited enforcement and high cost can undermine the effectiveness of legal tenure reform, while forest-owning communities with weak legal rights may in practice exercise a high level of control over forest land. For rapid impact, therefore, policy makers should look to alternative policy options that can also create enabling conditions for REDD+, under existing legal frameworks. These include mapping national laws and policies across sectors to identify perverse incentives, loopholes and conflicting priorities that exacerbate the drivers of deforestation, and engaging civil society networks with national forestry initiatives. This can fast-track improved tenure security for forest owners and creates strong enabling conditions for REDD+. **The report**

Putting the pieces together for good governance of REDD+: An analysis of 32 REDD+ country readiness proposals

World Resources Institute

Developing countries are receiving new financial and technical support to design and implement programs that reduce emissions from deforestation and forest degradation (referred to as REDD+). Reducing emissions from forest cover change requires transparent, accountable, inclusive, and coordinated systems and institutions to govern REDD+ programs. Two multilateral initiatives— the World Bank-administered Forest Carbon Partnership Facility (FCPF) and the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in developing countries (UN-REDD Programme)—are supporting REDD+ countries to become "ready" for REDD+ by preparing initial strategy proposals, developing institutions to manage REDD+ programs, and building capacity to implement REDD+ activities. This paper reviews 32 REDD+ readiness proposals submitted to these initiatives to understand overall trends in how eight elements of readiness (referred to in this paper as readiness needs) are being understood and prioritized globally. Specifically, we assess whether the readiness proposals (i) identify the eight readiness needs as relevant for REDD+, (ii) discuss challenges and options for addressing each need, and (iii) identify next steps to be implemented in relation to each need. Our analysis found that the readiness proposals make important commitments to developing effective, equitable, and well-governed REDD+ programs. However, in many of the proposals these general statements have not yet been translated into clear next steps. **The report**

Demand-side interventions to reduce deforestation and forest degradation

IIED

Global demand for food, wood products, biofuels and other agricultural products drives the majority of deforestation and forest degradation. The importance of trade and the increasing dominance of a relatively

small number of multinational traders and retailers suggest a role for demand-side interventions to reduce incentives for deforestation driven by the expansion of commodity production. A variety of demand-side measures have been developed and implemented over the last decade or more by government, private sector and civil society. Examples include legislation, public procurement policies, voluntary bilateral arrangements, multi-stakeholder roundtables, independent certification, moratoria, voluntary disclosure, investor activism and consumer campaigns. This paper reviews demand-side measures affecting five types of 'forest risk commodity', namely timber, soy, palm oil, beef/ leather and biofuels. Information was collected from literature, interviews and an international meeting to identify challenges and opportunities. **The report**

Approaches to benefit sharing. A preliminary comparative analysis of 13 REDD+ countries

CIFOR

The aim of this working paper is to provide a global overview and up-to-date profile of REDD+ benefit-sharing mechanisms, and to analyse the political-economic factors influencing their design and setting. The analysis draws primarily on a review of existing benefit-sharing mechanisms for REDD+ and natural forest management, namely fund-based approaches, market-based instruments, forest concessions, access and benefit sharing, and community forestry. We build on the results of contextual analyses in 13 countries: Bolivia, Brazil, Burkina Faso, Cameroon, Democratic Republic of the Congo, Indonesia, Lao PDR, Mozambique, Nepal, Papua New Guinea, Peru, Tanzania and Vietnam. These 'country profiles' were developed between 2009 and 2012 as part of CIFOR's Global Comparative Study on REDD+. Not surprisingly, the results of our analysis indicate clear challenges in the design and implementation of benefit-sharing mechanisms that will secure the broad legitimacy and acceptance of REDD+. **The working paper**

Integrated REDD+ accounting frameworks: Nested national approaches

USAID, LEAF, Winrock International, SNV, Climate Focus and RECOTFC

This decision support tool provides overall guidance on establishing national-level REDD+ accounting frameworks within which nested or jurisdictional approaches are integrated. The tool complements information provided in the LEAF Technical Guidance on Development of a REDD+ Reference Level (Walker et al. 2012) and the Winrock/FCPF Decision Support Tool for Developing Reference Levels for REDD+ (Harris et al. 2012) to form a 'package' aimed at guiding countries through the REDD+ readiness process. **The publication**

Safeguards in REDD+ and Forest Carbon Standards: A Review of Social, Environmental and Procedural Concepts and Application

Climate Focus

Safeguards are a set of principles, rules and procedures put in place to achieve social and environmental goals. In 2010, parties to the UN Framework Convention on Climate Change (UNFCCC) agreed in Cancun on seven broad safeguard principles for the implementation of REDD+ addressing transparency, participation of stakeholders, protection of biodiversity and ecosystem services, and respect for rights of indigenous and local communities. A year later, in Durban, an agreement was reached that parties undertaking REDD+ activities "should provide a summary of information on how the [Cancun] safeguards are being addressed and respected. **The publication**

Safeguarding forests and people. A Framework for Designing a National System to Implement REDD+ Safeguards

WRI

This report lays out a framework to help REDD+ countries develop a national system to implement the UNFCCC REDD+ safeguards. The framework presented here does not provide a ready-made solution, but it does provide a roadmap for navigating some of the choices that can arise during the design and implementation of national systems. The report also provides examples of how Brazil, Indonesia, and Mexico are progressing along this path. **The publication**

V.I JOBS

Project Officer – Africa Programme

Forest Peoples Programme – The deadline for application is 15th of June 2013

Forest Peoples Programme is looking for a Project Officer to support their Africa programme work in Cameroon and the Congo basin. Successful applicants will speak and write fluently in French and English, and have a master's degree (or higher) that is relevant to their work. S/he will join our work on the ground with forest

peoples and their support organisations to help indigenous and local forest communities protect their forests and exercise their self-determination. The successful candidate must be committed to the principle of self-determination for indigenous peoples and local communities. S/he must be prepared to travel often and be competent in providing technical support to our project teams around the Congo basin region, including reporting on activities and events, and monitoring budgets. **More**

VII. ANNOUNCEMENTS

Free, Interactive Weather Data for Forestry

aWhere Weather

aWhere Weather is an interactive online platform providing access to highly localized weather data, valuable for anyone doing research in forestry or work in forest policy or management. Access to weather data will help inform decision making and provide further context for forest based research. With the effects of climate change becoming a reality, the ability to access highly localized weather data is more crucial than ever before. Through the support of an international charitable organization, aWhere Weather offers free access to historical, daily-observed and 8 days of daily forecasted 'localized' weather data for locations in South Asia and West, East, and Southern Africa. Weather Data are available for the following variables:

- Precipitation
- Minimum and Maximum Temperature
- Minimum and Maximum Relative Humidity
- Solar Radiation
- Maximum and Morning Wind Speed
- Growing degree days (dynamically calculated for your base and cap temperature)

The data is available every 9km from the equator (akin to having a full meteorological station every 9km), and can be accessed online or through a daily or weekly emailed weather report. This platform has been designed to play a vital role in agriculture and land management initiatives providing accurate, highly localized weather data for researchers, extension workers and policy makers. **More**

CLIM-FO INFORMATION

The **objective** of CLIM-FO-L is to compile and distribute recent information about climate change and forestry. CLIM-FO-L is issued monthly.

Past issues of CLIM-FO-L are available on the website of ***FAO Forest and Climate Change***:

http://www.fao.org/forestry/climatechange/en/

For technical help or questions contact **CLIM-FO-Owner@fao.org**

The Newsletter is compiled by Marc Dumas-Johansen and Susan Braatz.

We appreciate any comments or feedback.

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