

**FONASO**



# **FONASO PhD Topic Catalogue 2009**

University of Copenhagen  
University of Göttingen  
University of Padova  
AgroParisTech-ENGREF  
Bangor University  
Dresden University of Technology  
Swedish University of Agricultural Sciences

University of British Columbia  
James Cook University  
Center for International Forestry Research (CIFOR)  
World Agroforestry Centre (ICRAF)  
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## FONASO PhD Topic Catalogue 2009

FONASO doctoral candidates will be part of research groups at two or more of the twelve FONASO partner institutions. Below is a list of PhD topics proposed by the research groups; all applicants must build their doctoral study synopsis around one of these topics. Applicants can only submit one application focusing on one of the below topics.

The topics are divided in the two main subject fields, within forest and nature management, addressed by FONASO: (i) economics and policy, and (ii) ecology and silviculture. Note that some topics may cut across these fields. Use the working title and description as the basis for developing your doctoral study synopsis.

The column “Lead” indicates where the principal supervisor will be located and thus where employment, upon successful selection, will take place. The following acronyms are used: KU (University of Copenhagen), Dresden (Technical University of Dresden), Göttingen (University of Göttingen), Bangor (Bangor University), SLU (Swedish University of Agricultural Sciences), AgroParisTech, Padova (University of Padova), JCU (James Cook University), and ICRAF (World Agroforestry Centre).

No.	Working title	Description	Lead
<b>Economics and policy</b>			
1	Decentralised forest management: equitable promotion of environmental objectives	Decentralisation of forest management in developing countries generally pursues the dual objective of forest conservation and economic development. These do, however, not automatically reinforce each other and different layers of society tend to rank them differently. Forest conservation often serves national and international level objectives of environmental services while the costs of delivering these services are generally borne by rural communities. On the other hand, many nations pursue decentralised forest management precisely because centralised forest management has failed to conserve forest resources. The transfer of management authority to decentralised groups is practically always contingent on the preparation of classic operational management plans to ensure that harvest does not exceed growth. This, however, involves technical requirements that rural communities generally cannot fulfil. Accordingly, they become highly dependent on assistance from forestry administrations thus increasing the risk of re-centralisation. National forestry services may also face capacity constraints in delivering technical service and in monitoring whether decentralisation actually result in forest conservation. Key research questions are: (i) what constitutes practical meaningful and safe minimum environmental standards for decentralised forest management, and (ii) how should national forestry services enforce and monitor the outcome of such standards cost efficiently and without re-centralisation?	KU
2	Forests, villagers and climate change: micro-level adaptive capacity	In order to improve the ability of communities and households in developing countries to adjust to ongoing and future climate changes, we need improved understanding of the risks they are facing. Climate change may significantly impact the assets, income and activities of households throughout developing countries. This is particularly true for households with low adaptive capacity, i.e. having constrained ability to cope with the impacts and risks of climate change, including limited ability to take advantage of opportunities. Recent years have seen major initiatives aimed at improving our knowledge on climate change risks and response options in developing countries, but our understanding of these	KU

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		complex relationships, with substantial spatial and temporal variations, remains fragmented and, in most locations, inadequate as a basis for developing viable and evidence-based adaptation strategies to the benefit of communities and ecosystems. In particular there is a dearth of studies based on empirical data that accurately describes local level livelihoods. Key research questions are: (i) what livelihood strategies are most vulnerable to climate change and what components in the strategies are threatened, and (ii) how might households pursuing vulnerable livelihood strategies adapt in the future.	
3	Uncertainty, risk, climate change and the economics of forest management	Risks like windthrow and forest fires have long been a threat to forestry. Risk levels depend on exogenous factors, biotic and climatic, but also on forest management, and are thus partly endogenous. Also, for specific stands or trees, the risk level depends on the spatial context. However, most research in risk and decision making in forest management use single-stand approaches, only few studies explicitly model risk as partially endogenous to stand treatment, and most studies focus on roundwood value only. Climate change adds more uncertainty to these risks. It gradually, but stochastically, shifts the mean of a stochastically fluctuating climate, thus changing the basic climatic conditions that are important to forest health and productivity. The effects of this on decision making likely resemble those resulting from market volatility. Studies are called for that build on the approaches also from investment theory under uncertainty. Key research questions are: (i) how can we handle endogenous risk in economic decision making, (ii) how can spatial relations, interdependence and non-market values be included in economic decision models handling climate change uncertainty and risks, and (iii) how can such decision models allow for adaptive optimization.	KU
4	Environmental service provision, forest owner motivations and instrument design	Privately owned forest areas play a significant role in the provision of environmental services, e.g. the protection and enhancement of biodiversity, the provision of recreational goods or the protection of groundwater. Various economic incentives are in place to ensure a preferable provision of these goods. Contracts offered to forest owners against improved environmental service provision are normally designed under the assumption that the owners possess mainly economic motivations. Thus, they provide forest owners with extrinsic motivations. Studies are needed that broaden the scope and investigate to which extent forest owners and their environmental service provision decisions may also be driven by intrinsic motivations. The PhD project should investigate the role of different types of forest owner motivations in undertaking environmental services provision, and how such motivations may be affected by or interact with incentive schemes. Key research questions are: (i) how can state-of-the-art instrument design theory be adapted to allow for various intrinsic motivation aspects, crowding out effects and similar, (ii) what is the empirical evidence for motivations that are not strictly rational in an economic sense, and (iii) how can such motivations among forest owners be revealed and assessed.	KU
5	Integration of conflicts in real-world systematic conservation planning	It is argued that if conservation is to become a societal priority, conservation science must be more engaged in the real world and reach scientific conclusions when knowledge is incomplete or not fully available. It has to incorporate analyses from the social sciences and humanities, and address conservation in a human-dominated landscape. A number of research studies have addressed the importance of including social conservation conflicts (e.g. population density, land encroachment or logging interests) in systematic conservation planning but none so far have included measures of the transaction costs of conservation and conservation conflicts. Key research questions: (i) how to improve the methods for assessing and predicting the transaction costs of conservation interests, and (ii) how to include the transaction cost of different conflict categories as well as conflict resolutions approaches. The questions should be answered in the context of uncertainty and climate change.	KU
6	Global conservation management	The forest ecosystem is one the most important harbours of biodiversity, but as resources are always limited, science is stressed to answer where, when and how forest conservation as such is provided most efficiently. Advances in the	KU

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		conservation planning literature show that conservation priorities should be selected based on approaches which integrate benefits and costs. A small number of studies have begun to consider how the inclusion of spatially explicit information on economic costs can affect the outcomes of conservation planning. These studies yield an unambiguous message: we can conserve biological targets at a fraction of the cost, or achieve higher targets for the same cost, if the spatial heterogeneity of conservation costs and benefits is included in designing future conservation. Key research questions are: (i) what are the methods for assessing and integrating global data sets on eco-system services (e.g., water, biodiversity, carbon) for improving the global conservation management efforts, and (ii) what are the implications of threats (e.g., deforestation, climate change, geo-political instability) on global conservation management efforts.	
7	Validation of stated preferences in environmental valuation of forest services	Recognising that there is a conflict between utilisation and protection of forest eco-system services – and there the value of non-timber products from a societal point of view plays an increasing role – there is a need for improving the methods for valuation of biodiversity and associated ecosystem services. Some of the most commonly used environmental valuation methods, e.g. Choice-Experiments or Contingent Valuation Method have as a goal the measurement of valid and reliable estimates of economic values, or willingness to pay for environmental goods. The contingent values should be free of sample-related bias, such as unit non-response, sample selection, or unbalanced item response on the contingent question. Most studies assume one-dimensionality in response items. Key-research questions are: (i) what are the perspectives of new approaches in psychometrics for developing a more valid questionnaire design in environmental valuation, and (ii) how to apply and evaluate psychometric modelling in forest service valuation	KU
8	The new role of forests and forestry in regions with decreasing population	Since 2009, for the first time in history more than half of the world's population is living in cities while many rural areas are increasingly facing a change or even decline in living conditions for the remaining people. New issues, e.g. demolition of infrastructure, natural succession, establishment of wilderness areas, resettlement of animals like wolf, bear etc. are coming into the focus. In this context, forests and forestry are supposed to play new roles in the future. In the framework of this project, a comparative analysis of selected case studies in two countries is intended to scrutinize the following research questions: What are the political framework conditions for forests and forested landscapes in the respective rural areas with (actors, political aims and programs, power relationships etc.)? Which role forests can play to keep the site economically attractive for the remaining population (including non-wood forest products and services)? How can forests and forested landscapes in rural areas be transformed into attractive destinations for tourism and recreation? Should depopulated regions mainly be used for biomass production or biodiversity conservation? Which special problems are increasing/or increasing along the urban-rural gradient?	Dresden
9	What incentives structures would be appropriate to promote sustainable and participatory practices in forest and nature management?	Community-based forest and nature management is considered a promising approach to sustainability. This even more when it comes to payment for ecosystem services (PES) – if local populations should not be losers in this new arena for NR-based income generation. The potential for new social conflicts is big. New theory development, frameworks and tools are needed to sustain the development of appropriate process-designs. As a key factor for success, it remains unclear what kind of incentives that would be required to draw all relevant parties to the table for constructive discourse and negotiation. This PhD study should focus on the actual and potential incentives around such participatory processes. Focus should be on power/influence based incentives as provided by the institutional setting, economic and other interest-based incentives that influences the participants, as well as ethically based incentives related to democracy and equity. Key research questions are: i) How can we comprehensively map the incentives structures around such processes, ii) How can we design processes that provide incentives structures that attract all relevant parties to the process?	KU
10	Climate change and	It seems evident that the globe will experience climatic changes that in many regions dramatically will change the	KU

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	conflict – frameworks and tools for managers	natural resource base for sustained human living. Such changes and following struggles to adapt will inevitably lead to new dramatic conflicts at all social levels. We need to understand and predict where such conflicts will occur and understand the nature of such conflicts. It will be extremely important to study and compare current cases of comparable conflicts as those expected in the wake of climate change by use of existing standardized frameworks. This PhD will study the emergence, development and outcome of such conflicts under various cultural, social and institutional settings by a case-study approach. Key research questions are: i) What are the critical parameters for the development of severe social conflict around climate change in natural resource based communities, ii) What preventive measures should be taken in vulnerable societies to secure constructive conflict management approaches, iii) What process-design frameworks and tools can be suggested to be useful for e.g. natural resource managers, policy makers and consultants.	
11	Supporting rural development by innovative product chains	Forests are mostly placed in rural areas, which especially in tropical countries suffer under structural weakness, deficits in infrastructure and which have generally low industrial capacities. This leads to underdevelopment, overexploitation of natural resources and the migration of the qualified work force. The use of forest products like NTFPs was overestimated in its contribution to a long term stabilization of the livelihood of rural people. Often the lack of capitalization led to a long term drain of knowledge, capital and work force to agglomerations. The capitalization can only be reached by the creation of value added cascades. This permits the re-investment in industrial capacities. The research focuses on the analysis of successful value added chains which are based on forest products and services like trees, fruits, agro-forestry products, tourism services, water supply etc. By analyzing different product and service chains and by comparing them based on a SWOT analysis successful strategies will be derived and tested in practical situations. Methodologically the research will be based on comparative case study analyses with an emphasis on East African countries. The long term contribution to rural development will be used as one key indicator for the success of the implementation of value added chains.	Dresden
12	Political economy of forest plantations in the tropics	The discussion on climate change leads to a re-interpretation of forest plantations in the tropics. The research focuses on an analysis of changing paradigms in the discourse on forest plantations. Based on a detailed analysis of the historical development of these forest plantations, the changing perceptions of different actors on the different levels (from local to global) are documented. In a diagnostics of the present situation special emphasis is put on socio-economic aspects of tropical forest plantations like benefit sharing schemes, labour and capital inputs, the impact on different for different levels of the society (local, regional, national, international). International investments, including activities of MCs and climate change mitigation instruments (CDM etc.) will be investigated in detail. The research methodology will be composed of literature review, expert interviews in international organizations (including FAO, ILO, and WB) and a comparative analysis of case studies in key countries in relation to sub/tropical forest plantations like Brazil, Indonesia and South Africa. The outcome of the research may contribute to a less subjective and more realistic view of forest plantations in tropical countries.	Dresden
13	Traditional medicine, livelihoods and health care	Traditional medicine and collection of medicinal plants are frequently regarded as important components of people's livelihoods and health care in developing countries. Their importance in health care is acknowledged by international organisations such as the World Health Organisation while nation states and international donors are eager to explore the economic and development potential deriving from their commercialisation and export. However, often policies are based on rough estimates with little empirical data to support them. In order to gain a better understanding of the actual and potential contribution of traditional medicines it is necessary to investigate the factors and processes at work in this field. Key research questions are: (i) to identify the different actors (at village, district and national level), market chains, important plants and habitats, quantities and prices involved in medicinal plant trade, and (ii) to investigate main	KU

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		purposes of applications, how traditional medicinal knowledge and use is distributed within and between communities (e.g. in relation to gender, experts vs. lay people, and different sectors of society), the share of plant-based remedies compared to other types of remedies, and the interplay between traditional medicine and biomedicine in people's health care strategies.	
14	Forests, people and power: Social and political dimensions of community forestry	Since the mid 1980s, there has been an increasing trend in developing countries to promote the active inclusion of local people as "communities" in the management of forest resources. This new approach, often referred to as community forestry, has been viewed as a win-win strategy to attain both more efficient forest conservation and livelihood improvement of the forest dependent communities. The introduction of community forestry usually entails numerous policy changes in rules and regulations to transfer more power and benefits to local communities. Yet, numerous empirical studies suggest that actual processes and outcomes are more complex and diverse than supposed and that some consequences may be contradictory to the policy objectives of community forestry. In order to understand how and why these unintended outcomes may arise, there is a critical need to empirically attend to dynamic interactions of the new policy of community forestry and concerned local actors. Key research questions might include: (i) how are community forestry initiatives implemented, by which actors and with what social and political effects, and (ii) how can the design and implementation structures of the community forestry be improved to achieve core objectives while mitigating unintended adverse effects.	KU
15	Forest boundaries and social equity	Forest boundary making has been widely adopted in decentralized forest governance as one of the key strategies to ensure more efficient and effective conservation of forest resources. This process involves construction of new forest use boundaries and allocation of specific management and use rights to certain groups of people. Much less attention has been paid to implications of this boundary making for social equity issues. Formalized boundary making risks bringing about adverse social and political effects, not only for those who are excluded by resource use boundaries, but also for some groups who are included. Key research questions include: (i) how are natural resource use boundaries formalized and instituted? (ii) what are social and political implications for those who included in and excluded in the new boundaries? and (iii) what measures can be sought to mitigate adverse social and political effects of boundary making while ensuring sustainability of forest resources?	KU
16	Improved knowledge-base for estimation of costs to society due to forest damages	European forests are continuously affected by various damages due to pests and pathogens. Due to projected climate changes that may cause shifts in the distribution areas of several damaging agents, and because of the globally increased transports, the magnitude of these damages may be expected to rise in the near future. This is likely to lead to increased costs to society in form of lost values of the forest and forest products. In order to effectively adapt to the changes in the forests' ecosystem services due to damages, the society needs improved and timely understanding of the magnitude, causes, consequences and the temporal dynamics of the economical costs due to damages. In most cases, the currently available estimates of these costs appear to be rough and simply based on the loss of timber value and/or immediate costs associated to replanting of damaged areas. These approximates tend to miss a more nuanced picture: the costs due to the loss of the recreational value of damaged forest areas, and the costs that are associated to altered biodiversity of forest ecosystems. To provide a scientifically sound and up-to-date knowledge-base for the estimation of costs due to forest damages, the proposed PhD project will focus on two key tasks: 1) to compile a detailed and nuanced analysis of the actual costs to society due to selected chronic and epidemic biotic damages, and 2) to compare these costs across different environmental and socio-economical gradients in a north-south axis across the European continent (deciduous vs. coniferous forests; production oriented forest areas vs. recreation/urban forest areas; sparsely and densely populated areas). The knowledge from the project is expected to be of value for the decision makers dealing with different aspects	SLU

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		of forestry (production, recreation, conservation and economics) at national and European levels.	
17	International forest regime as driver for sustainable national forest policies	During the past two decades international negotiations resulted in an international forest regime formulating goals and instruments for sustainable forestry. Nevertheless a mandate for binding rules does not exist and the informational instruments of the regime are highly fragmented. Therefore it is unclear whether the international forest regime has any substantial influence on national forest policies in order to achieve sustainable forestry. Based on political theory the complex power driven process of formulating programs of the international forest regime and implementing them at international and national level can be analyzed. We expect that the informal goals of national state institutions are the main determinants of such processes. The empirical cases could be chosen from countries worldwide. Key research questions are: (i) how does the international forest regime manifest at national levels in terms of programs and implementation activities (ii) how can this process be explained by international interaction of national state institutions and (iii) how can the impact of the international forest regime on national forestry be improved?	Göttingen
18	Optimizing community forestry within national power networks	Community forestry became a popular concept for reforming forestry in developing countries, promising sustainable forestry and poverty reduction by participative management of forests. Despite sophisticated models for optimizing the internal organization of community forests their successes are modest in practice. We assume that this is caused by the external network of stakeholders which has strong informal influence on community forests and often determine the biased outcome driven by the external interests. Based on political science such power networks surrounding community forests can be made visible by network analysis and provide the information needed for management strategies which will work in practice. The empirical cases could be chosen from countries worldwide. Key research questions are: (i) which are the power-networks influencing community forests and who are the most powerful stakeholders, (ii) how is the outcome of community forests determined by these stakeholders and (iii) how can power strategies be designed for sustainable forest management for people?	Göttingen
19	Modelling of climate change impacts on vegetation and livelihoods	Most models of climate change concentrate on the physical changes such as changes in temperature and precipitation that are likely to occur within the next 50 years. In order for this information to become useful for policy and decision makers it is necessary to translate this data into predicted impacts on a national scale on the natural resources which constitute the livelihood base of many rural people. Key research questions are: (i) how can economic, social, ecological and climate data be combined in novel and spatially explicit ways so that they become useful tools for national, regional and local decision makers, (ii) on the basis of existing data on present-day ecological zones and potential vegetation distribution in Nepal, how are these distributions likely to change in the future and what are the implications for local agriculture and natural resource use and management.	KU
20	How do Monitoring Limitations Influence the Optimal Design of Payments for Ecosystem Services Projects in Tropical Forests?	Among those concerned with tropical forest conservation there is currently much interest in the potential of payments for ecosystem services (PES) to provide significant new funding to tackle deforestation. If institutions can be established to allow those who benefit from the services that tropical forests provide (including carbon sequestration and supporting biodiversity) to pay those who bear opportunity costs by maintaining forests this would create incentives for forest protection. However, many challenges remain in the design and implementation of PES to ensure that their potential can be realised. Under PES, payments must be conditional on service supply: this requires that services can be monitored. However, monitoring has costs and these will vary with the service being monitored. This PhD will focus on the challenges of designing PES programs taking into account the relative costs and precision with which services can be monitored. Key research questions include: 1) can service provision in a biodiversity PES be monitored with adequate power? 2) how would the costs of direct monitoring of service provision compare with those of monitoring proxies, and how will using proxies such as forest cover influence incentives to reduce hunting and other sub-clearance damage to	Bangor

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		forest ecosystems? 3) what are the implications for monitoring when payments are based on multiple services (e.g. biodiversity-friendly carbon credits)?	
21	Reducing Emissions of Greenhouse Gases from International Supply Chains of Forest and Orchard Products	Many developing countries receive significant economic benefits from exporting fresh and processed products to developing countries. However there can be significant emissions of greenhouse gases associated with production, processing and transport of these goods. We have significant experience of undertaking carbon footprinting and life cycle assessment of food products from across Europe and in developing countries. We have also considered the socio-economic and health benefits that accrue to the farmers who participate in the export market. We want to understand the GHG emissions associated with relevant supply chains, and to identify a range of options for reducing GHG emissions. In addition to understanding the environmental benefits of any changes, we are also interested in understanding their impacts on the well-being of farmers and profitability in the supply chain.	Bangor
22	Economics of Managing Small Woodlands	In the UK and other parts of Europe, it is believed that there is a large resource of small, privately-owned woodlands that are essentially unmanaged. These woodlands may be left unmanaged for a variety of reasons, but it is likely that the fundamental causes are economic ones – the cost of forest operations are perceived as being higher than the market revenues generated or the increase in the woodlands’ economic value. As the cost of fossil fuel increases, and with it the cost of forest operations, is there a risk that interventions will become prohibitively costly and that more, not fewer, woodlands will be left unmanaged? This PhD will look at the trends in the costs/benefits of various forest operations, on woodlands of differing sizes and in different European contexts. By considering how the non-timber benefits of even small woodlands can be quantified and valued, it will consider the means, both through technological improvements and through regulation/incentivisation schemes, by which more small woodlands can be brought into active management.	Bangor
23	Mechanisms to reduce deforestation and Greenhouse gas emissions in Tropical forest	The deforestation and degradation of forests are still ongoing (representing 17.6 % of the Greenhouse gas emissions) and the Kyoto protocol hasn’t yet considered the forest sector and its role in climate change. The projects of REDD are carried out by the international scientific community with the aim of defining a protocol presenting measures able to reduce emissions due to deforestation and degradation of the forests. Actually, modalities of the implementation of these mechanisms are being discussed to define an institutional framework, the type of funding, scale of implementation, methodologies (reference scenarios, carbon leakage, etc.) and other points that permit their implementation and efficiency. Recently, experimental projects based on voluntary exchanges of carbon credits have been developed, principally in protected areas around tropical forests. This study should be a REDD case developed in an indigenous area of Brazilian tropical forest. Key research questions are: (i) how to ameliorate the methodology to model future spatial deforestation, elaborate a reference scenario and evaluate carbon credits of reduced deforestation considering the implementation of the project? (ii) How to associate spatial and macroeconomic data to local social and management data to integrate the strategic logics of the actors involved in the project?	AgroParisTech
24	Criteria and indicators for fairness and efficiency in PES	The terminology of Payments for Environmental Services (PES) has rapidly gained popularity with its focus on market-based mechanism for environmental service enhancement, but in reality it covers a broad spectrum of interactions between suppliers and beneficiaries of environmental services. Based on direct involvement in action research mode in evolving practices in Asia, we re-examine the paradigms and relate concepts to criteria and indicators of developing a PES mechanism. The RUPES and PRESA project in Asia and Africa have so far suggested that ‘co-investment in assets’ rather than ‘payments for services’ describes the emerging reality on the ground, with variable degrees of conditionality, various scales of collective action versus individual freedom and the need for a multi-scale approach to the regeneration and survival of natural capital. Research questions will include a testing of relevance and applicability of the current set of 10 indicators against three main paradigms:	To be decided, will incl. ICRAF

No.	Working title	Description	Lead
		Paradigm A "Markets for commoditized environmental service procurement", Paradigm B "Compensating/paying land users for accepting mandatory/voluntary restrictions on their use of land", and Paradigm C "Co-managing and co-investing in landscapes for reducing poverty and enhancing ES". Sites in both Asia and Africa are available for field testing.	
25	The role of Commiphora species in rural livelihood security and climate change adaptation in the Horn of Africa: Case study in Kenya and Somalia	The Great Horn of Africa's environment and major economic sectors are vulnerable to current climate change sensitivity, with huge economic impacts, and this vulnerability is exacerbated by existing developmental challenges such as endemic poverty, complex governance and institutional dimensions, limited access to capital, including markets, infrastructure, technology, ecosystem degradation, and conflicts. Commiphora sp. is multi-purpose trees sp. endemic in the Horn of Africa, which provides ecologically and economically important goods and services. Despite the socio-economic and ecological importance of C. sp., however, the farmers do not plant and/or manage it. There is observed constant decline in the present stock, and aggregately, most of the remaining is clustered natural stands. Since the removal of trees and vegetative cover is an important cause of land degradation, attention has recently focussed on the role of trees in sub-Saharan agriculture and the prospectus for restoring soil fertility and improving land productivity through incorporating trees and tree products with crops and/or livestock in integrated farming systems. The study focus on the identification of local people's livelihood strategies and coping mechanisms towards vulnerability to climate change, investigate role of C. sp. in livelihood security, sp. distribution/decline, sp. inventories, value chains and domestication of C. sp. as a major component in the farming systems in the drylands of the Horn of Africa, by using inventory techniques, plot sampling, regeneration techniques and socio-economic questionnaire.	To be decided, will incl. ICRAF

### Ecology and silviculture

26	Lateral water and carbon flux in tropical forest ecosystems	Despite the significance of tropical forests to the global carbon cycle, our understanding of the processes and inter-connections underlying biogeochemical cycling in the tropics at a range of temporal scales lags that of the temperate/boreal systems that lie within the borders of industrialized nations. The Austral-Asian tropics are the area under the climatic influence of the eastern Indian and Asian-Australian monsoons and greater than 60% of the total materials flux between the land and the ocean occurs in this region. Considerable effort has gone into understanding controls on the vertical fluxes of carbon between the atmosphere and vegetation in tropical forests. There has been less effort devoted to developing a comparable understanding of the controls on the 'lateral fluxes' of water and carbon (inorganic, particulate and dissolved organic carbon) from tropical forest catchments. This project will examine the links between vertical fluxes and lateral fluxes of carbon and water in wet tropical upland and lowland forest systems with the aim of developing an integrated 'whole system' carbon budget for these contrasting sites. The project will utilize instrumented sites near the James Cook University Cairns campus in the Australian wet tropics, with direct access to the analytical infrastructure available on the campus.	To be decided, will incl. JCU
27	Assessing tropical forest carbon dynamics on an altitude transect	Approximately 168PgC, made up of organic material of differing ages and degradability, is stored in tropical forest biomass and soils with a significant proportion of this being sensitive to changes in environmental conditions (primarily temperature and precipitation) on annual to decadal timescales. For obvious logistic reasons there have also been comparatively few studies in steep tropical forest regions, though much of the remaining forest in the tropics is in mountainous terrain precisely because access is difficult. These forests are potentially of additional significance as the rate of future temperature increase is likely to be faster at higher altitude than lower altitude in the tropics. This project	To be decided, will incl. JCU

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		will use an established network of permanent forest plots that range in altitude from 30-1500 metres above sea level to develop an understanding of the dynamics of litter and root turnover as a function of elevation and nutrient availability, both important components of the tropical forest carbon cycle and likely to be sensitive to future climate change. All plots are readily accessible from the James Cook University Cairns campus in the wet tropics of Australia and the project will utilize the analytical facilities available on the campus.	
28	Environmental services provided by tropical agroforestry for organic production	In Central America high-input or modern coffee production technology has achieved high yields in optimum growing conditions for coffee in monoculture or under limited shade. The use of petroleum-based fertilizers and pesticides have contributed to shortcutting ecological processes such as unclosed nutrient cycles and eroded foodweb diversity but also to environmental deterioration such as soil erosion, water pollution and GHG emissions. In organic coffee systems, efficient, organic nutrient cycles are expected to replace leaky, open inorganic fertilizer flows. In these systems, leguminous shade trees play an important role through nitrogen fixation and internal nutrient cycling. The regular application of composted organic matter from outside and “natural” methods of disease and pest control are also key technologies of organic production. The environmental services provided by the organic production systems under agroforestry in comparison to conventional management need evaluation and recognition in the price premium offered by the organic coffee market. Key research questions are: (1) What is the contribution of the legume tree strata management and organic input to soil emissions of N <sub>2</sub> O + CH <sub>4</sub> and soil C dynamics in organic production systems? (2) How to improve the methods for assessing the GHG balances of coffee agroforestry systems?	AgroParisTech
29	Forests for food, restoration and climate: potential of emerging strategies of agroecosystems and natural forest restoration through fertilization based on tree by-products	Forests are among the most stable continental ecosystems, having built highly fertile soils on which agricultural productivity currently relies. However, the mechanisms for maintaining the underlying properties in the soils found under forests remain largely unknown. In a global context of increasing climate variability, decreasing soil quality and increasing economic and environmental costs of exogenous inputs in agriculture and forestry, ecosystem mimicking theories suggest that application of organic inputs resembling those established in forest ecosystems may address a range of problems in agroecosystems. Among these inputs, ramial wood and biochar, derived from wood waste, raise increasing interest for their agricultural and environmental (including alteration of the global carbon cycle) potentials. Due to lack of knowledge in forest soil ecology, in the variability of raw materials and of ecosystems functioning across ecozones, much remains to be accomplished before these inputs can safely be promoted. Key research questions handled in the PhD program will evaluate the potential of ramial wood and biochar: What are the best management practices for sustainable farming or natural forest restoration? How do such practices fit in agricultural or restoration activities (resource availability, compatibility)? What is the full environmental balance (life cycle assessment, REDD) of these practices?	AgroParisTech
30	Deforestation and ecosystem service evaluation	Harvesting is an inevitable consequence of commercial forest operations and is typically seen as having negative environmental consequences. Of most importance is the loss in water quality, carbon storage, aesthetics and biodiversity. This PhD will examine the speed of recovery of the ecosystem by looking at existing chronosequences of forest sites at different times before and after the start of harvest operations for periods up to 50 years. Assessments will be made of above and below ground diversity (e.g. birds, beetles, microbial), greenhouse gas emissions (CO <sub>2</sub> , CH <sub>4</sub> and N <sub>2</sub> O), carbon storage and catchment water quality. This will be achieved with experiments, models and existing datasets. The information will be used enhance our ability to understand and model land system change and adequately inform policies and planning.	Bangor
31	Extreme drought and fire: What are the	There is an increased prevalence of severe fire in European forest ecosystems. The overall effects of fire on ecosystems are complex, ranging from the reduction or elimination of aboveground biomass to impacts on belowground physical,	Bangor

No.	Working title	Description	Lead
	consequences for forest functioning?	chemical and microbial mediated processes. Climate change may increase the severity of forest fires which may affect their composition and functioning. This PhD will examine whether severe summer drought exacerbates the potential for catastrophic fire events. It will assess the impact of drought and heat stress on fire fuel production, combustibility and subsequent quality of product (wood ash and charcoal) on forest soil quality and seed germination.	
32	Net mitigation effects of different forest and reforestation systems	Forest CDM will eventually be viable after the CDM reform and the voluntary carbon market offers many opportunities to achieve compensation for mitigating climate change. Critical to the success of reforestation and rehabilitation sites is evidence of the magnitude of carbon sequestration, both above- and belowground. Developing proxies that allow upscaling of forest biomass to remote sensing and satellite tools is one way to bring down the significant MRV costs. The second big uncertainty in this context is the net effect of soil greenhouse gas fluxes. Nitrous oxide and under waterlogged conditions methane are potent GHGs that act contrary to carbon sequestration from land-use change in soils. These gases show high spatial and temporal variability and are hence difficult to budget over space and time. But in order to develop unbiased carbon sequestration budgets, their fluxes must be accounted for. Both aspects of carbon accounting require the use of modelling tools. Key research questions are: (i) how can we best upscale biomass from forests and complex landscapes to accurately represent carbon sequestration in reforestation and rehabilitation projects at lower costs; and (ii) to what extent do nitrous oxide and methane affect land-use change induced soil carbon sequestration budgets?	To be decided, will incl. ICRAF
33	Forests and climate in African drylands	Deforestation around the East African Mountains has led to locally dryer climate and decreased cloudiness. This has manifested itself as glacial retreats, but also affected wildlife sanctuaries, and crop and livestock production around those mountains. Regional deforestation in the Guinea forests over the last century has led to a drying out of the summer monsoon over West Africa. This is hypothesised to have worsened droughts in the Sahel. The interplay between forests and regional to local variations in climate is poorly understood. Sustaining a functional water cycle is a key issue for mitigating climate change, and trees are key components in conserving the water cycle. Key research questions are: (i) what spatio-temporal scales are relevant for managing the local vertical water cycle (evapotranspiration going up, rainfall coming down) (“how much reforestation is needed for preserving East African glaciers”); (ii) what spatio-temporal scales are relevant for managing monsoon rainfall driven by the tropical rainbelt (“Can reforestation be used to mitigate drying spells in the Sahel”); (iii) Can multi-storey agroforestry systems perform as well as a natural forests in sustaining the water cycle, including preserving soil water infiltration and soil water storage capacity?	To be decided, will incl. ICRAF
34	Genecological management of trees in the agroforestry parklands of sub-Saharan Africa	Native trees such as <i>Parkia biglobosa</i> , <i>Vitellaria paradoxa</i> , <i>Adansonia digitata</i> , <i>Balanites aegyptiaca</i> are examples of important trees species in agroforestry parklands in sub-Saharan Africa. Pulp and seed provide important sources of vitamins, sugars and proteins, and are used almost daily in many regions. Management strategies that can enhance the fruit production of the native tree are virtually unknown, but from cultivated fruit trees it is known that external factors may have a profound effect on the production and quality of the fruits. Of especial interests is the demographic-genetic structure in areas where the species during the last decades have become increasingly rare as result of changed agroforestry management systems, land use patterns, or climatic changes. Fruits production is expected to relay of effective pollinations between mature trees in the landscape mediated by insects, birds or bats. Decreasing density of the trees has unfortunately taken place in many areas, and fruit production per trees of the remaining trees is potentially at risk due to lack of pollinators or large distance between con-specific individuals. These aspects are presently un-investigated, and important steps towards knowledge based management therefore include studies on pollination distances and effects of pollination limitations on fruit production and fruit quality of selected species at the Northern fringe of their Sub-Saharan distribution area. Also, genecological studies (DNA-markers combined with	KU

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		ecophysiological bio-essays) offer the potential of improving the understanding of how these species are expected to react on the on-going climate changes in agroforestry parklands of sub-Saharan Africa.	
35	Application of DNA based tracing techniques for supporting logging legislation and international certification regimes	Illegal logging leads to loss of natural resources and environmental values, unsustainable and illegal logging practices are associated with a number of negative effects such as violation of indigenous peoples rights and public or private ownership, violation of local financial and tax regulation, and corruption of civil servants. Timber is an international commodity, and wood consumers in one part of the world therefore influence the logging activities in other parts of the world. The potential role of international timber trade in driving unsustainable logging has led to development of certification systems that shall ensure the consumers that the purchased timber originates from sustainable managed forest. However, there is a need for research in effective mechanism that than establish and verify the correct taxonomic classification and geographic origin of traded timber. Research within the field is anticipated to focus on development and analysis of DNA based methods targeting (1) identification/verification of species, (2) identification/verification of logs and wood products from certified concessions and/or (3) assignment/verification of logs and wood products to geographical regions, concessions or populations within a specified range. Such research can comprise collection and laboratory studies of selected species and origins in relation to and cooperation with on-going timber certified tropical timber trade. Theoretical simulation studies can be applied and outcome compared to the observed results in order investigate the expected general applicability of the tested methods. The feasibility of applying the timber tracing methodologies into relevant legislation, certifications schemes and chain of custody control mechanisms can be an important object in the research topic.	KU
36	Integrating the tree resource outside the forest (TOF) into forest inventories	Forest inventories are developing towards comprehensive data collection tools that have been extending their scope beyond forests for quite a while. In many countries, forest inventories do now have the character of a tree inventory and lands outside the forest are included both into the field inventory and into the remote sensing assessment. The reason is that such trees play a crucial role for rural livelihoods but also for timber production. Examples are India, where an estimated about one third of the harvested timber comes from outside forests, or Guatemala where an estimated about one fourth of the tree biomass is outside forest. However, integrating non-forest lands into a large area forest inventory in order to make estimations of the tree resource outside the forest faces a number of challenges mainly because of the low density and the variable spatial distribution of the resource. The objective of this PhD research is to analyse, develop and compare specific sampling designs and (possibly adaptive) plot designs in combination with appropriate remote sensing based mapping and modelling approaches. This research has a methodological character and can be done in any region where there is a variety of different occurrences of TOF, for example on agroforestry lands, homegardens, or along roads. The candidate should be ready to deeply “dive” into forest inventory techniques and sampling statistics, and into remote sensing applications including digital image processing.	Göttingen
37	Integrating Non-Timber Forest Products (NTFPs) into large area forest inventories	Forest inventories are developing towards comprehensive data collection tools that have been extending their scope beyond traditional forest variables for quite a while. Non-timber forest products have an economic relevance in many forested areas and serve as food, medicine, raw material for tools and a tradable product for many rural communities. In some cases, high value NTFPs contribute a high share of the total income. They are also the target for bioprospecting and biopiracy. However, in many cases, not much is known about the sustainability of utilization when the traditional forms of subsistence harvesting are replaced by more intensive collection approaches that target at regional and international markets. It is the objective of this PhD research to analyse, compare and further develop sampling and plot design techniques to integrate the assessment of NTFPs into large area forest inventories. That may also include the development of models that relate remotely sensed topographic and vegetation features to the presence of a particular	Göttingen

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		<p>classes of NTFPs. This research has a methodological character and can be done in any region where there is a variety of different occurrences of NTFPs including, for example, medicinal and aromatic plants, firewood, wildlife, tree bark, or fruits.</p> <p>The candidate should be ready to deeply “dive” into forest inventory techniques and sampling statistics, and possibly also into remote sensing applications including digital image processing when remote sensing based models are to be developed.</p>	
38	Long-term effects of rehabilitation on important ecosystem services	<p>Large areas in semi-arid regions are degraded due to over-intensive use followed by soil erosion. As demonstrated in numerous development projects, land rehabilitation has the potential to return the vicious spiral by stopping desertification and loss of agricultural land. Rehabilitation may include small or large scale soil ridges, rock bounds and tree planting. Introduction of agro-forestry systems also has an effect on soil conservation and fertility. The rehabilitation methods aim to enhance the availability of water and nutrients in the soil and thus to enable production in soils previously unsuited for production. Maintaining and increasing the soil organic matter pool is one of the pivotal elements in order to preserve and enhance soil fertility. Several studies have evaluated the short term effect of soil fertility and soil organic matter development and agricultural output following different rehabilitation methods, but the long term consequences have not been addressed to the same degree. It seems that rehabilitated agroecosystems have the potential to increase production and thus improve the livelihoods of the local population as well as a significant potential for sequestration of carbon and climate change mitigation. The aim of the project is to evaluate long term effects of well established rehabilitation techniques in terms of soil fertility and carbon sequestration. Relevant materials are available from the Sahel region.</p>	KU
39	Importance of beech admixtures for water retention and runoff formation in monocultural spruce stands	<p>Many forests in Central Europe are characterized by even-aged plantations of monocultural conifers - in mountainous areas mostly Norway spruce (<i>Picea abies</i>). Recent silvicultural efforts have aimed at increasing the percentage of natural deciduous species, notably European beech (<i>Fagus sylvatica</i>). There is distinct evidence of positive ecological effects of such conversion measures. However, it is poorly understood how beech quantitatively affects water retention and runoff formation. Interception in beech is lower whereas the deeper rooting of beech in comparison to spruce may increase macro-porosity and, thus, deep percolation. Furthermore, the deeper rooting of beech may positively affect the pre-event soil moisture (storage capacity). The role of stemflow in beech is totally unclear and requires experimental investigation. Current perceptions range from a better infiltration corresponding to the deep root architecture to an increased formation of surface runoff concentrated in the butt area of beech trees. The PhD project is focused on the combined explorative and experimental analysis of relevant interactive processes and the model-based estimation of water fluxes. Event-based field experiments under adjacent spruce and beech will be conducted using irrigation sprinklers in the throughfall areas. In the stemflow areas novel-type infiltration experiments with artificial stemflow will be employed. Resulting water flows will be estimated by soil moisture measurements and exploiting dye-tracers added. Results will be used for upscaling tree species effects on water flow dynamics from single tree plots to slope situations and entire catchments.</p>	Dresden
40	Linking restoration of tropical forests with climate change mitigation	<p>Tropical forests, ca. 52% of the world’s forests, are subjected to the highest rates of deforestation and land conversion globally, in turn having significant impact on global carbon cycle through increased carbon emissions and loss of above- and belowground carbon storage capacity. Reducing emission from deforestation and enhancing carbon sequestration through reforestation are strategies to help stabilize the global climate. Several restoration efforts have been initiated with the goal of recovering the structure and function of tropical forests. Though implicit in functional recovery, climate change mitigation has never been a central theme of restoration goals in the past. Thus, to integrate climate change mitigation with ecological restoration, scientific evidence is still needed to discern the magnitude of carbon sequestered</p>	SLU

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		by restored forests, plantations and natural successions. Key research questions are: (1) Which forest ecosystems are the best carbon sinks? (2) Which species are the best for climate mitigation while restoring degraded sites (3) Is there a threshold level for each species in the forest community after which carbon storage is negligible? (4) How fast can carbon be stored in forests and what factors affect this rate? (5) Can rates of carbon sequestration be accelerated?	
41	Spatio-temporal species distribution in hedges in relation to environmental changes	Hedgerows are an omnipresent element of European landscapes. They are key habitats for conservation and diminish negative effects of forest fragmentation by linking woodlands. A question important to hedgerow ecology and conservation is the spatio-temporal change of woody plant composition in relation to environmental changes. We therefore propose a replicated drought experiment for analysing such effects as likely consequences of climate change. Droughts, which are expected as a consequence of climate change, will be simulated with a special roof design for decreasing precipitation whilst avoiding a rise in temperature. In the past woody hedge species were mainly assessed visually similar to the approach of estimating the species composition of vascular plants. Advances in surveying methodology involving terrestrial LIDARs and digital cameras in connection with terrestrial photogrammetry now allow a more precise spatio-temporal measurement. The objectives of this PhD research are (i) to take replicated measurements considering soils, proximity to the sea etc., (ii) to analyse the data with random set statistics and (iii) to develop a generic spatio-temporal model of species changes in relation to both current precipitation patterns and drought conditions. This research will provide an important baseline to evaluate biodiversity changes in hedges as a result of climate change.	Dresden
42	Managing forests for carbon storage	Forest plantations throughout Wales are being managed with little consideration of long-term carbon storage or forest soil sustainability. The practice of clear felling forest plantations at 60 – 80 years of age results in reduced carbon storage in mature trees and degradation of the soil resource. Both of these outcomes result in a net increase in greenhouse gas production, however, the extent of this increase is poorly understood. We propose to investigate the role of alternative forest management practices in reducing greenhouse gas emissions, thereby assisting in the attainment of desired 3% per year reductions in emissions over the next twenty years. Douglas fir, a fast growing economically important conifer species in North America which has been imported to Europe some 120 -150 years ago is suggested as a model species in this research project. We propose a replicated spatially explicit experiment in 100year old Douglas fir plantations in Canada and Wales under different management scenarios including selective shelterwood thinnings, clear felling and no thinning as a control. We will select 12 forest stands within Wales and British Columbia within which we will be able to assess: (1) soil carbon emissions; (2) ecosystem carbon accrual. All variables will be evaluated in replicated subplots within each stand. The outcome of this project will provide an important baseline from which to evaluate long term carbon dynamics and forest sustainability in managed forests throughout Europe.	Bangor
43	Flash floods and sediment transport in mountain watersheds in the context of the climate change	Many mountain valleys are highly populated as well as increasing anthropogenic factors represent causes of vulnerability for land, environment and inhabitants in temperate and maritime macroclimatic zones. Furthermore the effects of climate change are particularly active in mountain areas: changes of forested areas, reduction of slopes covered with snow, evanescing of the permafrost, extremization of intense rainfalls, decreasing of soil permeability during dry periods, quick snowmelt processes after winter. Such factors might affect the magnitude of the hydrologic responses of mountain watershed heavily, and can generate dangerous flash floods combined with soil erosion, shallow landslides triggering, and transport of large amounts of sediments along the river network. Investigations and modelling are necessary to assess the impact of climate change on the processes which drive the overall behaviour of mountain and hilly catchments during floods. Key research questions are: (i) how can we estimate the flooding hazards and the more sensitive mountain areas in the context of the climate change (ii) how can Geographical Information Systems be	Padova

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44	Climate change and greenhouse gas fluxes from tropical forests	<p>informed and managed to forecast the expected scenarios and to take decisions on active and passive actions for land protection, and (iii) how can we improve the robustness of the modelled impacts.</p> <p>Globally, tropical forest soils are the largest natural source of the greenhouse gas (GHG) N<sub>2</sub>O, an important sink of atmospheric CH<sub>4</sub>, and cycle &gt;10% yr<sup>-1</sup> of atmospheric CO<sub>2</sub>. Despite the significant role of tropical forests on GHG fluxes, research efforts on how changes in climate (e.g. rainfall) affect soil processes of GHG gas production and consumption are few. These soil processes are proximally regulated by soil aeration or moisture status which, in turn, is distally influenced by rainfall regimes. Climate change predictions agree that considerable changes in rainfall regimes may occur in the tropics. How changes in rainfall regimes will affect GHG fluxes can be investigated at present by using a space-for-time substitution approach. Such investigation involves representing the time factor (i.e. predicted rainfall changes) by forest sites across a natural gradient of rainfall regimes. Forest sites should be located along a relatively short distance such that soils are comparable, forests are of similar age, and sites reflect the long-term differences in rainfall regimes. Main goals are to 1) quantify changes in GHG fluxes as influenced by changes in rainfall regimes, and 2) establish predictive relationships with the main driving factors.</p>	Göttingen
45	Developing accounting methods for soil carbon in tropical soils following land use changes	<p>Soils contribute about 15% of the emitted CO<sub>2</sub> when tropical forests are cleared for agricultural uses. Accounting methods for greenhouse gas (GHG) emissions following forest clearing in the tropics have been focused mainly on changes in above-ground carbon stocks even though considerable changes in soil organic carbon (SOC) stocks have been reported. The main reasons why below-ground SOC stocks are presently not included in accounting methods are the paucity of data and the lack of generic relationships describing how SOC stocks change. Apart from peat lands, the highest tropical SOC stocks are found in deeply weathered soils. These soils typically contain more SOC in the subsoil than in the topsoil and there is evidence that a considerable part of this SOC is affected by land use changes. The main goals are to 1) develop a simple method to predict changes in SOC stocks following land use changes in deeply weathered soils based on independent variables such as land use history, soil, landscape characteristics, and climate using advanced statistical methods, and 2) test the developed method using an independent dataset of SOC stocks down to 3-m depth.</p>	Göttingen
46	Large-scale monitoring of forest degradation to improve carbon management decisions	<p>If the IPCC (2007) estimated deforestation to contribute nearly 20% of annual global greenhouse gas emissions, the Bali Conference (2008) also included forest degradation in developing countries within the UNFCCC mitigation agenda, as the second 'D' of the REDD mechanism. However, developing countries are often lacking of efficient monitoring schemes for the vast areas of tropical forests they may still harbour. They are generally devoid of any efficient strategy for large-scale field inventory, while high-resolution (i.e. decametric) remote sensing techniques remain of limited help for discriminating finer classes than the most strongly contrasted forest types (e.g. closed vs. open canopy, deciduous vs. evergreen) or for assessing biomass variations beyond a saturation threshold of ca. 200 t.ha<sup>-1</sup>. (i.e. far below 400-450 t.ha<sup>-1</sup> generally encountered in tropical forests). There is consequently an urgent need to improve methods of large-scale forest characterisation that could allow an accurate quantification of the reduction of emissions caused by forest degradation. Key research questions are: (i) what are the forest structural, physical or functional properties that could be used to precisely assess tropical forest degradation; (ii) can the most recent systems and methods, such as infra-metric remote sensing instruments and 3D virtual forest simulators, provide a means to accurately monitor these properties on a large-scale basis.</p>	AgroParisTech
47	Mangrove conservation and coastal changes	<p>Due to the various and numerous services supplied by mangrove ecosystems, e.g. coastal fisheries and shoreline protection against storms, one hectare of this ecosystem has been estimated to represent a value of \$200,000 to \$900,000 per year. The position at the land-sea interface causes mangroves to undergo pressures from both human activities and</p>	AgroParisTech

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	mitigation	the oceanic environment. In coming decades, the predicted increase in the sea level and number of storms are widely recognized as the major threats to mangroves. If the millions of coastal residents who benefit from valuable resources and the 'bioshield' capability of mangroves are to survive and continue to enjoy the benefits of living in coastal environments, then we need to quickly and proactively evaluate the impact of coastal changes on mangroves. The failure rate of over 80% of the most international mangrove planting projects was due to a lack of knowledge of ecological (fruit production period) and physical (tidal cycle, substrate elevation) processes governing the mangrove development dynamics. We forget that mangrove forests have a remarkable ability to cope with extraordinary levels and types of environmental constraints. Some species possess certain biomechanical traits which permit to resist storms and remain firmly anchored to the soil substrate whereas other species demonstrate exuberant colonization strategies. Key research questions are: (i) how can pristine coasts with mangroves help for the conservation of imperilled coasts? (ii) what are the leading biomechanical and (ii) regeneration traits for self-maintaining ecosystems? (iii) what are the consequences of coastal changes on carbon storage in mangroves?	
48	Environmental Impacts of Rapid Road Expansion in the Asia-Pacific	Roads, highways, and other transportation infrastructure are proliferating dramatically in the Asia-Pacific region. A small sampling of major ongoing projects includes the Myanmar-China and Mekong Highways in Indo-China; the Aceh and Samling Roads in Aceh and Sumatra, respectively; and the Andaman Islands Road in the Indian Ocean. In addition to these major projects, smaller road networks for industrial logging, mining, and oil and gas development are expanding rapidly in the region. Such roads sharp increase physical access to forest frontiers and often lead to rapid increases in forest colonization and invasions, deforestation, poaching, land speculation, and secondary-road expansion. Along the lines of our long-term studies in the Amazon and Congo Basin, we propose to assess the impacts of linear infrastructure on forests and wildlife at three spatial scales: (1) local-scale (0-1 km) studies to evaluate road and linear-clearing impacts on the movements, mortality, and distribution of selected terrestrial forest vertebrates, such as large-bodied mammals, primates, birds, and apex predators; (2) medium-scale studies (1-20 km) of road impacts on poaching intensity and patterns and rates of forest encroachment; and (3) strategic regional and national-scale studies using remote sensing, GIS, and biophysical and socioeconomic variables to model and project the larger-scale impacts of planned infrastructure on forest cover, carbon storage, and high-profile faunal groups. These studies will lead to a cutting-edge understanding of the environmental impacts of existing and planned infrastructure-development schemes in the Asia-Pacific region, and will have vital implications for environmental decision-makers.	To be decided, will incl. JCU
49	Implications of global change for provenance transfer	Varieties of forest trees with exactly known adaptive characteristics are rarely available. On the other hand, molecular studies and field trials proved important differences among populations of most forest trees and large genetic diversity within most populations. Accordingly, the selection of reproductive material which is well adapted to the conditions at planting sites is difficult. Natural regeneration or the use of local, autochthonous reproductive material safeguards adaptedness in a constant environment. Thus, local material has been recommended and preferred by practitioners. However, global warming implies that local material might be no longer adapted to future climatic conditions, and a south to north transfer of reproductive material has been suggested as a strategy to cope with climate change. The genetic consequences of a transfer and its implications for adaptive and economic traits have rarely been investigated. It is proposed to study (molecular) genetic and adaptive variation of trees in translocation experiments and seedlings growing under abiotic stress in climate chambers. Key research questions are: (i) what are genetic and adaptive responses of seedlings to growth in different climatic conditions, and (ii) is the transfer of provenances from south to north a strategy to cope with climate change and to enhance adaptedness?	Göttingen
50	Impact and	In-channel wood strongly affects hydraulic, sediment, morphological and ecological processes in mountain channel	Padova

No.	Working title	Description	Lead
	management of Large Wood Debris (LWD) in mountain alpine forested catchments (A field and GIS assessment)	networks, e.g. increasing biodiversity, increasing turbulence, and promoting pool formation. On the other hand, large wood may increase flood hazards because it can clog bridges, cause localized erosions and increase the total channel roughness. Channel clearing from vegetation and wood are activities with highly negative consequences in terms of habitat diversity and ecological functionality of mountain streams. To limit the environmental impact of these practices, they should be carried out only in channels where a real hazard related to excessive wood load is present. In order to identify such channels, models which simulate wood input and its transfer along mountain streams can be utilized. Almost all these models have been developed in USA, especially in the West Coast, considering either old-growth forests or extensive clear cut management. The first developed models simulate a constant input rate, while the most recent ones use more complex forest growth models. The main recruitment processes are natural mortality, windthrows and harvesting. These models have been developed and calibrated on North American basins, so they are unreliable in other areas such as the European Alps, featuring higher levels of human impacts and a larger role of hillslope instabilities. Key research objectives are: (i) development and application of a GIS-based model for the simulation of recruitment, storage and transport of in-channel large wood on catchments of the Dolomites (Italian Alps); (ii) to quantify actual and potential in-channel large wood volume of forested sub-catchments, catchments and total basin of the Dolomites; (iii) to develop improved strategies for management of LWD, such as log, within river channels; (v) to produce best practice guidelines for managing LWD.	
51	Response of Tree Populations to Environmental Change	Most tree species contain high levels of within- and among-population genetic diversity in molecular and adaptive traits. Adaptive traits that may be important in responding to predicted climate changes include: tolerance of drought and waterlogging; temperature requirements for growth, and for breaking seed and bud dormancy; wind stability; pest and disease resistance. Studies are needed to determine (1) if local, autochthonous populations of tree species contain sufficient adaptive genetic variation to withstand predicted changes in climate; (2) if non-local populations are better adapted to such predicted changes in climate, implying that non-local provenances should be used for afforestation and regeneration schemes; (3) if predicted changes in climate are so great that the required adaptive genetic variation is not found in any population of the species, implying that a change of species is required. The PhD would carry out a systematic review of genetic variation in relevant adaptive traits to identify where knowledge gaps exist. The systematic review would be followed by genetic tests of one or two species to estimate levels of within- and among-population variation in adaptive traits. Tests would be done in controlled environment growth rooms and greenhouses, and reciprocal transplant experiments would be established at sites across Europe, using climatic matching to identify test sites.	Bangor
52	Increasing Tree Cover in Agricultural Landscapes: What is the Trade-off Amongst Different Ecosystem Services?	In many tropical and temperate countries land-use policy strongly favours tree planting in agricultural landscapes to benefit a range of ecosystem services, e.g. fuelwood, biodiversity, hydrology, carbon storage. However, farmers are often resistant because they perceive that trees will reduce their agricultural productivity, so they prefer any tree planting to occur in unproductive locations where there is already semi-natural vegetation that is already of value for ecosystem services. We need to determine where in agricultural landscapes tree planting will create the greatest increase in net ecosystem services? This analysis will span multiple scales to consider the relative benefits of large woodland blocks versus corridors, strips, hedgerows and isolated trees. It should also assess the relative benefits of tree planting at different topographic positions from ridge top to riparian zone. The project will require systematic review of existing evidence, followed by fieldwork with monitoring of biodiversity, water and nutrient cycling, and landscape ecology assessment and modelling. It will result in new understanding of how to use trees to improve functional landscapes, integrating both ecological and economic connectivity and resilience.	Bangor

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<b>No.</b>	<b>Working title</b>	<b>Description</b>	<b>Lead</b>
53	How Can We Characterise and Measure Forest Degradation for It To Be Included in Reduced Emissions from Deforestation and Forest Degradation (REDD) Schemes?	Current international policy favours the inclusion of schemes to reduce tropical deforestation in international carbon trading and emissions reduction targets. Including reduction of forest degradation in these schemes provides valuable opportunities for the most cost-effective reduction in carbon emissions. However, tropical forests are naturally dynamic so a major challenge is to characterise degradation and measure its rate so that the benefits of reduction can be quantified in terms of carbon stocks. We need to define the ecological dimensions of existing forest disturbance regimes (in terms of area, intensity, frequency and specificity of disturbance) as a baseline against which to judge the additional benefits of a project intervention. To ensure that payment schemes equitably reward the stakeholders who will bear the greatest opportunity costs of a project, our methodology must be applicable across scales from a local community's slash-and-burn agriculture within a secondary forest mosaic to commercial logging. The project will seek to test the consequences for long-term carbon storage in forests at a landscape scale of contrasting forms of forest degradation, and develop cost-effective methods of monitoring the benefits of alternative interventions to reduce degradation and promote forest recovery.	Bangor
54	Carbon Neutral Catchment	Over the coming century, the UK and Europe are committed to a major reduction in carbon emissions from all sectors of the economy, including land use. At the same time, we expect to produce at least as much, if not more, food, fuel and fibre from our land resource. This PhD seeks to answer a simple question: Is it possible to deliver the three Fs (food, fuel, fibre) in a carbon neutral catchment? Using catchment-scale case studies from across Europe, this PhD will investigate the extent to which land use activities contributing to, and mitigating against, greenhouse gas emissions are balanced against one another. Physico-economic scenarios will be modelled to determine how this balance can be shifted through technological improvements and regulation/incentivisation schemes, and where, exactly, the carrying capacity imposed by carbon neutrality lies.	Bangor
55	Measures to Stabilise Soil Carbon and Reduce Carbon Turnover in the Soil	Much is known about the biotic and abiotic factors which influence the turnover and release of soil carbon. Aromatic organic carbon compounds resulting from lignin breakdown and other processes represent recalcitrant molecules in the soil which may be vulnerable either to microbial metabolism under conditions of high aeration, higher soil pH and calcium levels, and low nitrogen or, as smaller molecules, may be lost by leaching under sufficient water flow. In this project it is intended to stabilise such aromatic compounds within the soil by the addition of various nitrogen inputs (mineral, organic and wastes) at different loadings. The types of compounds formed and their stability will be studied.	Bangor
56	Climate change effects on tropical dry forests	Climate models generally predict increased variability in rainfall from year to year, more frequent extreme drought events, and temperature rises. Reduced rainfall approximately 8,000 years ago led to the replacement of tropical rainforests in the Amazon basin with more drought-tolerant species. This may give insights into the changes we can expect with a drier climate in the future, but CO <sub>2</sub> levels are double now what they were then, and the fertilising effect of CO <sub>2</sub> confuses the predictions. Plants functioning at elevated CO <sub>2</sub> levels use water more efficiently and their reduced water demand will give them greater tolerance of reduced precipitation. There is an expanding body of research on the effects of these atmospheric changes on rainforests, but to date no work has been conducted in dry tropical forests, whose tree species are already adapted to prolonged drought conditions. This neglect is despite the importance of these forests, as they constitute over 40% of global forest cover, and are considered to be the most threatened ecosystem on earth. Key research questions are (i) how are tropical dry forest species affected by changes in temperature, drought and CO <sub>2</sub> ; (ii) research in dry forests indicated that facilitative (benefiting) effects of the tree canopy for seedlings growing underneath are stronger when it is drier, and that alleviation of the moisture stress in the rainy season switches the effect of the interaction from facilitative to competitive. How will this interaction change with longer periods of drought?	Bangor
57	Indigenous Oil Trees	There are several indigenous tree species in Africa that have been demonstrated to yield good quality oil for human food	Bangor

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No.	Working title	Description	Lead
	in Africa	and cosmetics. They still remain underutilised and undomesticated. As a result of deforestation and conversion of land to mono-crop agriculture, some of them are disappearing and some are even on the verge of extinction. In order to rescue those that are disappearing, and promote those with good quality oil in order to improve the livelihoods of local communities, we need to identify such indigenous tree species, compile information on their current status, characterise their oils, develop efficient propagation methods for their domestication, and carry out cost-benefit analysis to guide local investment. Key research questions are: (1) how resilient are these species in view of the changing climate? (2) what are the most sustainable ways of establishing and managing plantations of such species on farm? and (3) how economically feasible is local investment based on these species?	
58	Biochar Production, Application and Efficacy in Managed Forest Ecosystems	Biochar provides a way to offset and prevent greenhouse gas emissions in forests. There is currently limited understanding of the fate and significance of biochar added to temperate or boreal forest soils, yet land application of biochar is currently being promoted as a means of improving site productivity while creating long-term carbon storage. Biochar is the solid product produced from the pyrolysis of carbonaceous material (e.g. biofuels, wood, organic wastes). When added to soil, this natural product locks up carbon in an extremely stable form for thousands of years, thus having potential to be used as a balance for excessive carbon emissions from fossil fuels. Biochar is thought to increase soil quality in a number of ways: (1) it is rich in nutrients and has been shown to be an effective source of delivering nutrients to plants; (2) it improves soil physical condition; (3) it may stimulate symbiotic mycorrhizal fungi enhancing plant's response to stress; (4) it may reduce NO <sub>x</sub> emissions; (5) it promotes nitrification in temperate and boreal forest soils, yet reduces NO <sub>3</sub> <sup>-</sup> leaching in tropical environs; (6) it reduces the leaching of pesticides to water. Although these positive benefits of biochar have been recognised by the indigenous population of Amazonia for centuries, its potential application in the developed world has only just become recognised. In this project we would investigate the efficacy of biochar production and application in forested ecosystems of Western Europe and Eastern Australia. Biochar will be produced from regionally sourced forest residuals and applied locally. Sapling growth, soil physical properties and soil biochemical processes will be observed following biochar applications to forest soils. Assessments of the role of biochar in the long-term sustainability of managed forest systems will be undertaken.	Bangor
59	Vegetation modelling as a tool for conservation planning, including on-farm tree diversification	Forest ecosystems are increasingly under threat from climate change, land use changes and degradation. Conservation and sustainable use strategies could include the diversification of agricultural landscapes, restoration of degraded landscapes and conservation of areas of particular biodiversity value such as hotspots. Key to these strategies is better utilization of valuable tree species in and outside forests, which requires the selection of well-adapted species. For most forestry and agroforestry tree species, there is limited information available on their suitability for use in different environments. However, species suitability can be inferred from the distribution of vegetation types and their species assemblages. Current information on the distribution of vegetation zones is mostly static and descriptive. By modelling the distribution of vegetation types using high resolution global environmental data sets, derived geospatial data such as topographic indices and new habitat distribution modelling approaches (such as maximum entropy and boosted regression trees), distribution maps could be obtained for large numbers of species that are indigenous to Africa. Moreover, these maps could project changes of habitat distribution under specific climate change models. Key research questions are: (i) what are key factors influencing the distribution of natural vegetation, (ii) how could spatial suitability models help to predict changes in tree species distribution and (iii) how can conservation and sustainable use strategies under current and future climates be improved in eastern Africa.	To be decided, will incl. ICRAF
60	Can association genetic methods be	In trees, quantitative trait loci determine productivity and adaptability, but research on such traits is difficult because of the timescales involved in breeding studies due to long generation intervals, and the large number of loci involved.	To be decided, will incl.

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	<p>applied to agroforestry trees? Possibilities for increasing production and adapting to global challenges such as climate change</p>	<p>Technological advances based on 'genomic' approaches combined with advances in association genetics, are being applied to map traits of interest, to better understanding these features and then selecting appropriate productive types (e.g., fruit earlier and in higher yields) or adaptive (e.g., adapted to saline environments or suited to drought conditions) for farmers' requirements. Such methods are being applied to temperate trees as pines and poplars, but have potential for neglected tropical trees important to poor smallholder farmers. The utility of such methods requires testing by choosing a small number of important case study trees, developing markers and identifying candidate genes for assessment, sampling and screening of test populations, and validating results with existing field trials on growth and adaptation. Key research questions are: (1) Can markers determine if human management and participatory tree domestication lead to changes in important gene frequencies in tree stands (2) Can appropriate cultivation strategies then be identified using such information.</p>	ICRAF
61	<p>Recycling of organic matter for energy fuel briquette production and healthy environment in Kenya</p>	<p>In Kenya 2.4m tones of charcoal is consumed annually, contributing to destruction of forest resources. Forests degradation could be addressed through recycling organic matter from urban areas, agricultural residues and tree by-products for production of briquettes and growing agroforestry trees species for charcoal. Communities recycling organic matter for briquette production face technological challenges affecting quality of the product. Research will be organized into two phases where phase one aims at characterizing the community briquetting practices. Briquettes from the groups will be analysed for calorific value, moisture content, ash content, volatile matter at the University of Nairobi and will also be analysed for carbon monoxide, carbon dioxide and fine particulate matter to assess implications on climate change and indoor air. Phase one data will be used in designing phase two aimed at building on the community practices, through setting experiments at the university and briquettes will be analysed as stated above. Charcoal dust and saw dust used in the experiments will be from agroforestry trees species grown within 150kms radius of Nairobi city where charcoal is sourced for their subsequent promotion for energy production through agroforestry systems.</p>	<p>To be decided, will incl. ICRAF</p>