Daniel Stietenroth, Wolfram Lorenz, Surya Tarigan, Adam Malik (Eds.)

Proceedings
International Symposium
"The Stability of Tropical Rainforest Margins: Linking Ecological, Economic and Social Constraints of Land Use and Conservation"

Georg-August-University of Goettingen (September 19-23, 2005)

Universitätsdrucke Göttingen

STORMA
INDONESIAN-GERMAN RESEARCH
www.storma.de

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Preface

This proceeding volume results from the submitted abstracts of the international symposium "*The Stability of Rainforest Margins: Linking Ecological, Economic and Social Constraints*" held on September 19 – 23, 2005 in Göttingen, Germany.

Tropical rainforests disappear at an alarming rate causing unprecedented losses in biodiversity and ecosystem services. Rainforests are hot spots of biodiversity as well as important carbon sinks. Despite an increased recognition of the value of these and other valuable public goods provided by tropical rainforests at national and international levels, the rainforests of Asia, Africa, Australia and Latin America continue to be seriously threatened by various forms of human encroachment.

The analysis of policies and socio-economic and ecological determinants that either stabilize or threaten tropical forest margins requires a holistic interdisciplinary scientific approach. Such an approach has been adopted by a large scale research program titled "Stability of Rainforest Margins in Indonesia" (www.storma.de). This research program started in 2000 and is jointly conducted by the two German Universities, the Georg-August-University of Göttingen (GAUG) and the University of Kassel (UNIK), and by two Indonesian Universities, the Agricultural University of Bogor (Institut Pertanian *Bogor*, IPB) and the Tadulako University (UNTAD) in Palu.

Referring to the main research foci of STORMA, the symposium features three interconnected thematic foci of interdisciplinary research. They refer to changes in the extent and intensity of agricultural and forest land use in tropical forest margins and their implications for rural development and for conservation of natural resources such as biodiversity, soils and water.

The first focus "*Integrated spatial modeling of land use in tropical forest margins*" concerns rain forest margins around the world which comprise a variety of land-use systems, with forest gardens, annual crops in slash-and-burn and agroforestry systems, as well as intensive cultivation, mostly in the valleys. An understanding of the dynamics of land-use change and related resource degradation under various policies scenarios is required, and strategies to reduce and potentially reverse degradation processes are to be developed.

The second focus "*Sustainable management of agroforestry systems*" concerns low-intensity agroforestry which may support high biodiversity stabilizing ecosystem functioning, in particular when shaded by natural trees and neighboured by natural forest. In contrast, high-intensity agroforestry with planted shade trees and in an agricultural landscape context may be characterized by less environmental benefits and high agrochemical inputs. In this focus, the ecological and socio-economic benefits of different management practices will be compared and related to patterns and processes in natural forests.

The third focus *"Ecological and socio-economic impacts of different forest-use intensities"* analyzes ecological and socio-economic benefits and costs across different types of forest use. The consequences of low- and medium-intensity forest-use practices, such as selective timber and rattan extraction, for biodiversity and ecosystem functioning are assessed.

We are grateful to our sponsors, namely the German Research Council (DFG), the Georg-August-University Göttingen and the University of Kassel. Our special Thanks goes to the Universities *Institut Pertanian Bogor* (IPB) and *Tadulako University* (UNTAD) in Palu for their cooperation in the Collaborative Research Centre (SFB 552) "*Stability of Rainforest Margins in Indonesia*" (STORMA).

Daniel Stietenroth
Wolfram Lorenz
Surya Tarigan
Adam Malik

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CALL FOR PAPERS
INTERNATIONAL SYMPOSIUM
THE STABILITY OF TROPICAL RAINFOREST MARGINS: LINKING ECOLOGICAL, ECONOMIC AND SOCIAL CONSTRAINTS OF LAND USE AND CONSERVATION
19 – 23 September 2005
at Georg-August-University of Göttingen, Germany
Jointly organized by:
Georg-August-University of Göttingen and University of Kassel (Germany)
Institut Pertanian Bogor and Universitas Tadulako (Indonesia)
Supported by:
DIVERSITAS (an international programme of biodiversity science)
LUCC (Land-Use and Land-Cover Change)
IHDP (International Human Dimensions Program on Global Environmental Change)

THEMATIC SCOPE

Tropical rainforests disappear at an alarming rate in Africa, Latin America and Southeast Asia causing unprecedented losses in biodiversity and ecosystem services. Despite an increased recognition of the value of these goods at national and international levels, rainforests continue to be seriously threatened by various forms of encroachments such as low-intensity harvesting of non-timber forest products by the rural poor, largescale plantation forestry by the state or private actors, and the conversion of forested land by smallholder farmers, either temporarily through shifting cultivation or permanently through the establishment of agroforestry, cropping or grazing systems.

The stability of rainforest margin areas has been identified as a critical factor in the preservation of tropical forests. In this context, these areas include the forest rim and the belt of agricultural land use systems, which is usually surrounding the forests. Stability has an ecological, social and economic dimension. Understanding the ecological, social and economic determinants of land use change in tropical rainforest margins on different scales is the key to identify more suitable development objectives, such as nature conservation, poverty reduction, and economic development of rural areas.

OBJECTIVES

This international symposium provides an open platform for all leading scientists from socio-economic and natural sciences interested in the use and conservation of tropical rainforest resources. The research papers presented at the symposium will contribute to an improved understanding of the processes that have stabilizing or destabilizing effects on ecological and socio-economic systems of tropical rainforest margins. Interdisciplinary papers that strive to integrate environmental, technological and socio-economic issues are especially welcome. We will invite some of the excellent papers for a synthesis book (Springer) and a special issue of an international journal. The symposium will feature the following three interconnected thematic foci of interdisciplinary research.

KEYNOTE SPEAKERS
Diogenes Alves (Instituto Nacional de Pesquisas Espaciais, Sao Jose dos Campos SP, Brazil)
Konrad Fiedler (University of Vienna, Vienna, Austria)
William L. Laurance (Smithsonian Tropical Research Institute, University of Panama, Panama)
Ivette Perfecto (University of Michigan, Ann Arbor, USA)

FOCUS 1: Integrated spatial modeling of land use in tropical forest margins
Rain forest margins around the world comprise a variety of land-use systems, with forest gardens, annual crops in slash-and-burn and agroforestry systems, as well as intensive cultivation, mostly in the valleys. An understanding of the dynamics of land-use change and related resource degradation under various policy scenarios is required, and strategies to reduce and potentially reverse degradation processes are to be developed. Papers presenting spatially explicit models or scenario analyses are especially welcome. Papers should focus on one of the following or related topics:

- Assess the influences of actors (e.g. households, social groups, institutions, government policies) on common pool or privately owned resources comparing different scales
- Analyze direct and indirect social, economic and environmental net benefits generated by different land use strategies
- Compare different types of resource use and land-use systems and their impact on the environment (ecology, hydrology, soils, nutrient and carbon fluxes)

FOCUS 2: Sustainable management of agroforestry systems
Low-intensity agroforestry may support high biodiversity stabilizing ecosystem functioning, in particular when shaded by natural trees and neighbored by natural forest. In contrast, high-intensity agroforestry with planted shade trees and in an agricultural landscape context may be characterized by less environmental benefits and high agrochemical inputs. In this focus, the ecological and socio-economic benefits of different management practices will be compared and related to patterns and processes in natural forests. Papers should address one of the following or related topics:

- Quantify biodiversity, ecosystem functions, and socio-economic driving forces in different types of agroforestry systems
- Identify differences of human-dominated tropical landscapes to forest areas with respect to biodiversity and environmental benefits
- Assess the relation of above- and belowground biodiversity to ecosystem services such as biological control, pollination and decomposition

- Identify ecological and socio-economic benefits or detriments of agroforestry systems and characterize improved management systems considering ecological and socio-economic objectives

FOCUS 3: Ecological and socio-economic impacts of different forest-use intensities

In this focus, ecological and socio-economic benefits and costs across different types of forest use will be analyzed. The consequences of low- and medium-intensity forest-use practices, such as selective timber and rattan extraction, for biodiversity and ecosystem functioning will be assessed. Papers may focus on trees and epiphytes, insects and soil biota in relation to socio-economic benefits and costs. The income derived from different types of forest use may change with socio-economic group differing in wealth, ethnicity, education, and other criteria.

- Assess forest-use intensities maintaining high biodiversity and recommend conservation concepts
- Identify differences and similarities in the response of plant and animal groups to forest-use changes and relate below- and aboveground biodiversity to ecosystem functioning
- Relate ecological and socio-economic benefits and costs to forest-use intensity

Keynote Speakers

Diogenes Alves

Instituto Nacional de Pesquisas Espaciais (INPE)

From Research to Sustainability: A few Lessons Learnt in the Brazilian Amazon

Total deforested area in Brazilian Amazon has increased from 10 million hectares in the 1970s to more than 60 million in the early 2000s, following the expansion of the agricultural frontier initiated in the 1960s in the region. Land cover and use changes (LUCC) of such magnitude have motivated several initiatives from scientists – to improve the understanding of Amazonian ecosystems and to investigate LUCC impacts -and from decision makers and stakeholders – to attempt to curb deforestation rates and to seek sustainable forms of land use.

In this paper, we will review two major science efforts – the Large-Scale Biosphere-Atmosphere Experiment in the Amazon (LBA) and the Science & Technology Subprogram (S&T) of the Pilot Program to Conserve the Brazilian Rain Forest (PPG7) – and two cases of multi-lateral arrangements involving environmental monitoring and management – Ecological-Economic Zoning (ZEE) and deforestation monitoring programs – in an attempt to understand how their results may have contributed to reduce or mitigate LUCC impacts.

LBA is a multi-national multi-disciplinary research effort built to investigate the biological, biogeochemical and physical functioning of the Amazon, and the effects of LUCC and climate changes on such functioning. Specific attention is given in LBA science plan to the issues of the sustainability of development in the region and to the influence of the Amazon on global climate. LBA research strategy attempted to integrate several scientific disciplines from climate to hydrology to biogeochemistry to social and human sciences, to address the experiment's research questions.

The PPG7 is an international cooperation program supported by donations from G7 countries and counterparts from the Brazilian government with the objective of protecting Brazilian rain forests and promoting sustainable development. Its S&T Subprogram includes two major components: the first one primarily aimed at the strengthening of infrastructure conditions in two important research centers in the region (Belém-based Museu Paraense Emilio Goeldi – MPEG – and Manaus-based Instituto Nacional de Pesquisas da Amazônia – INPA) and the second one dedicated to research funding based on competitive approval of projects and on consultations with the civil society to define research foci.

The ZEE is a modality of prescribed land use zoning executed at the Federal, State and local levels that is expected to be based on sound technical analyses and on broad consultations with stakeholders. Some attempts to formulate and pass ZEE legislation have addressed the crucial problem of bringing together stakeholders and conciliating very varied interests and stakes with technical recommendations.

Deforestation monitoring in the Amazon has evolved from exploratory, concept-proving studies in the 1970s, into multi-lateral arrangements involving a number of Federal and State organizations during the 1990s, resulting in some achievements in capacity building and in the ability of these organizations to track deforestation, direct enforcement operations into critically deforested areas and use deforestation information in land use planning.

The paper will first review some lessons learnt from these efforts, and then proceed to discuss how these lessons affect science. For that purposes, we will try to understand how these experiences contributed to discuss the question of sustainability and how this understanding might have affected the formulation of scientific agendas and the development of research projects.

Although the initiatives under discussion may appear to be disconnected, they all painfully demonstrate how crucial it is to consider the intricacies of the arrangements involving stakeholders, and suggest a significant distance between scientists, decision makers and stakeholders. At the end, we will point out that the formulation of new scientific agendas to cover the question of sustainability will require rising inter-disciplinary research to new levels, and consider very diverse theoretical and technical perspectives to encompass the intricate relationships that touch decision makers, stakeholders and the academia.

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Konrad Fiedler

University of Vienna

Moths at Tropical Forest Margins - How Megadiverse Assemblages Respond to Forest Use and Recovery

Herbivorous insects are a major fraction of terrestrial biodiversity. However, it remains poorly known how much of this diversity may be maintained in secondary forests or mosaics of regenerating vegetation. Such knowledge is essential for assessing the conservation value of non-pristine forests, be it as areas destined for sustainable use in forestry or as buffer zones around protected areas. Moths are interesting model systems to study such effects, since they are extremely species-rich, have herbivorous larval stages, and show a wide variety of bionomic strategies (e.g. with regard to host plant specificity, recolonisation potential, and dependence on adult resources). Moreover, moth faunas can rapidly be assessed by light-trapping. Recent an ongoing studies on moths in various tropical regions (SE Asia: Borneo, Malaya; Africa: Mt. Kilimanjaro;S America: Ecuadorian Andes) revealed that moth faunas of disturbed or regenerating forests are remarkably diverse. However, responses turned out to be taxon-specific. Sphingidae ensembles are particularly robust against moderate habitat disturbance, whereas Pyraloidea, Arctiidae and Geometridae respond much more sensitively and may therefore qualify as indicator taxa for monitoring purposes. These differences can be linked to larval as well as adult life-history characters and resource requirements. Scale is also an important issue, since recovery of moth ensembles depends on flight capacity and recolonisation potential of adult moths. Succession habitats at the margin of natural forest may occasionally even hold richer local moth ensembles than the forest itself, but distance and fragmentation effects strongly constrain moth diversity in anthropogenically transformed landscapes.

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Willliam Laurance

Smithsonian Tropical Research Institute

Ecosystem Decay in Amazonian Forest Fragments: Implications for Conservation

I will synthesize key findings from the Biological Dynamics of Forest Fragments Project, the world's largest and longest-running experimental study of habitat fragmentation, and consider their implications for tropical forest conservation. Although initially designed to assess the influence of fragment area on Amazonian biotas, the project has yielded insights that go far beyond the original scope of the study. Results suggest that edge effects play a key role in fragment dynamics, that the matrix has a major influence on fragment connectivity and functioning, and that many Amazonian species avoid even small (<100 m wide) clearings. The effects of fragmentation are highly eclectic, altering species richness and abundances, species invasions, forest dynamics, the trophic structure of communities, and a variety of ecological and ecosystem processes. Moreover, forest fragmentation appears to interact synergistically with ecological changes such as hunting, fires, and logging, collectively posing an even greater threat to the rainforest biota. The rapid expansion of new roads, highways, and other transportation infrastructure in Amazonian countries, and large increases in cattle ranching and soybean farming, suggest that the already-alarming rates of forest loss and fragmentation will accelerate even further in the future.

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Ivette Perfecto

University of Michigan

Combining Environmental and Economic Goals: The Case of Coffee in Mesoamerica

The shaded coffee system in Mesoamerica has been found to harbor high levels of planned and associated biodiversity. Two ways of stimulating farmers to maintain these highly diverse systems is

1) to demonstrate the function of biodiversity for the production and sustainability of the farm, and

2) to provide some sort of premium price for the biodiverse coffee.

In the first part of this talk I will present an example of the function of biodiversity with respect to pest management, focusing on complex interactions between natural enemies, pests and mutualists. The second part of the talk will focus on the issue of coffee certification. I will present an approach for exploring price premiums for shade coffee by integrating knowledge about the relationship between shade, yield, and biodiversity.

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FOCUS 1:

Integrated spatial modeling of land use in tropical forest margins

Kamaruddin Abdullah

Bogor Agricultural University (IPB)

Nana Mulyana, Bogor Agricultural University (IPB)
Idung , Biotrop

Hydraulic Analysis Using GIS

Forest are also nature's tool for managing watersheds through their wet and dry seasons, and maintaining sufficient water supply for drinking, irrigation, transportation, and others human uses. Deforestation and poor logging practices led to erosion of the rivers banks and silt accumulation, and have become the major factors behind this disaster. Deforestation of marginal land is linked to desertification because it removes root system resulting in severe top soil erosion and removing natural barrier to wind erosion.

Land use change and deforestation in Central Sulawesi is a very serious problem to handle especially in tropical forest margin. The complexity of the problem is usually indicated by local climatic and socio-economic conditions of the people living in the forest margin. Poor economic conditions of the people can not prevent them from defying the law and are sometimes intruding even the off-limit area of Lore Lindu National Park. Such activities will result in dynamic forest area change which, at the end will destroy the overall annual water yield, water quality and total water availability.

In this study raster model is used as the basis of hydrologic analysis using GIS. For this purpose, the research sites are divided into 500 m x 500 m, but whenever necessary a smaller pixel size will be use. Into a single pixel different attributes will be provided so that spatial and temporal changes in land use and land cover and its impact on water balance can be studied.

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Kamaruddin Abdullah

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Joerg Priess, University of Kassel (UNIK)
Joseph Alcamo, University of Kassel (UNIK)

Use of Powerism to Study Water Balance

Land use change from a tropical rain forest to another land use type can effect different type of hydrological processes. Forest can absorb water and regulating run-off, keeps top soil in place, and prevent rivers and streams from silting up, which is a major cause of flooding. In hilly and mountainous terrain, tree cover stabilizes the soil; prevent landslides, which can occur after heavy rain fall.

Due to uncontrolled human activities and population pressure, however, such natural balance can be destroyed, irreversibly, unless a better land use planning can be made available and secured by law and local government regulation.

POWERSIM is a powerful software to study temporal change of land use on water balance. Considering the dynamics of local human behaviors, different scenarios can be studied so that later, available water resources can be distributed in a sustainable manner to fulfill various water demand for domestic, industry, agriculture, animal production, etc.

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Muhammad Ardiansyah

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Detection and Monitoring of Forest Cover at the Rainforest Margin in Central Sulawesi Using High Resolution Satellite Images

Rate of deforestation in Indonesia is estimated about 1.35 million ha annually between 1950 and 2000. The deforestation causes some ecological impacts including destabilization of the rainforest margins and the greenhouse gas emission that ultimately causes global climate change. Dynamic of forest margin need to be observed in order to anticipate the ecological impacts and their relationships with environmental changes. To do so, a combination of medium and high resolution satellite imageries was employed because this technique has capability to acquire and to analyze data in appropriate spatial and temporal scales. This paper focuses on the contribution of QuickBird satellite data for the identification and monitoring of tropical forest cover and land cover changes at the rainforest margin of the Lore Lindu National Park, Central Sulawesi. The landscape in Central Sulawesi is characterized by an inhomogeneous pattern of land use systems. Hence, only very high resolution satellite data are able to detect the extent and changes of land cover types. The key parameters of the forest and cover at the rainforest margin (type, stem density, DBH, height) have been mapped in the field according to the plot type concept of the SFB-552 (plot type "A" to "F"). The results suggest that spatially explicit high resolution data combined with context-based classification technique are useful to provide richer information for the detection and monitoring land use intensity and forest cover based on class membership and detailed land use patterns.

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Legal Aspects and their Implications on the Data Management in International Interdisciplinary Research Projects - a Case Study from the SFB 552 "Stability of Rainforest Margins"

Characteristics of SFBs (Sonderforschungsbereich ~ collaborative research center) are a interdisciplinary research concept and an envisaged duration of 12 years. The SFB 552 comprises more than 100 researchers from 14 disciplines working in four universities in Germany and Indonesia. The integration of the diverse backgrounds into a consistent and comprehensive research approach over such a long time span is itself challenging and resulting synergy effects are the main advantage compared to other approaches.

A common data and information management in hetereogenuous research groups is viewed as the foundation of any integration. Therefore, in the SFB 552 the central data management has been delegated to a sub-project. The main objective of that sub-project is the implementation of an information system that assures the access and correct interpretation of any data and information ever collected or surveyed during SFB 552 related research activities. For ease of access a WWW based implementation using a LAMP (Linux, Apache, MySQL, Perl) system was chosen, allowing a web browser the user is accustomed to as graphical user interface. For correct interpretation the collection of structured meta data, that is data describing the actual research data, has been stipulated.

However, experience has shown that uncertainty with respect to user related rights on data prevents the central data management to yield its full integrative capability.

This poster contribution will elucidate on the relevant rights held on data in international research projects by third parties or the researchers themselves. The applicability of intellectual property rights such as copyrights or rights resulting from patents or competition law as well as sovereign rights by states, groups or individuals other than the project members involved will be discussed. Thus, international regulations on intellectual property, their implications within the framework of international research and their consequences for the

implementation of a web based information system will be subject of the following outline. Furthermore, the legal framework covering the aforementioned aspects within the SFB 552 will be illustrated, emphasizing options and mechanisms of bilateral agreements between project parties and their effect against the background of international regulations.

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Alex Awiti

World Agroforestry Centre

The Effects of Land Use and Land Cover Change on Soil Functional Capacity: Patterns, Process and Implications

This study examined the effects of forest conversion and cultivation on patterns of soil nutrients, key soil process i.e. carbon dynamics, steady state infiltration and water retention along a chronosequence comprising three age classes namely; Forest (0 yr), recently cultivated, RC (< 25yr) and historically cultivated, HC (> 30yr). The study further examined the implications of changes in patterns and processes on plant primary productivity potential. A combination of satellite imagery, tree-structured classifiers and anecdotal accounts from farmers was used to ascertain land use history. Control-impact pairs and cluster survey methods were implemented in the three age classes to collect soil samples and to run infiltration and water retention tests. Patterns of change in soil nutrients in the three sites were assessed using laboratory methods. Spectral reflectances of plant and soil samples were obtained using a FieldSpec (TM) FR spectroradiometer. Soil properties were calibrated to spectral reflectance using partial least square (PLS) regression. Hybrid maize seedlings were grown for 14 days under greenhouse conditions to assess root: shoot biomass allocation patterns in the three sites. A Chlorophyll normalized difference index (ChlNDI) was used to evaluate differences in shoot chlorophyll concentration. Stable carbon isotopes were used as tracers to evaluate the effects of deforestation and subsequent cultivation on input dynamics of soil organic carbon in forest-cultivation pairs. Changes in infiltration and water retention were determined using single ring infiltrometers and pressure membrane apparatus respectively. C, N, Mg, Ca K and ECEC were significantly lower ($P>0.0001$) in RC and HC compared to Forest sites. C, N, Mg, Ca, ECEC, pH, clay, sand and silt were reliably predicted from spectral reflectance ($r^2 >0.7$). Discriminant analysis revealed that mean topsoil spectral reflectances differed significantly among the three sites (Wilks' Lambda= 0.0151, $F = 12.63$, $P < 0.0001$). Conversion of C3 dominated forest to maize based (C4) systems changed the 13C/12C ratio plant residue inputs to soil organic carbon. The rate of loss of C3 derived carbon was seven times higher than the rate of accretion of C4 derived carbon under low input subsistence cultivation. Mean residence time of C3 derived in topsoil soil organic carbon was 69yr. Steady state infiltration rates were significantly lower ($P<0.0001$) in RC and HC soils compared to Forest soils. The bi-exponential water retention model revealed marked differences between soils under Forest and soils under cultivation. Macro pore volume declined by 73% in RC and HC soils compared to Forest soils. Maize seedlings grown on nutrient rich Forest soils had allocated higher biomass to shoot relative to root compared to seedlings grown in RC and HC soils. Shoot samples from seedlings grown on Forest soils had higher chlorophyll concentration. Discriminant analysis revealed that mean shoot spectral reflectances of maize seedlings differed

significantly (Wilks' Lambda= 0.00359 F = 19.6, P < 0.0001). The systems approach (patterns, process and implications) advanced in this study provides a precursor for building a structured learning framework that aid the formulation of general ecological principles for sustainable management of agro ecosystems. It expands the assessment of soil function beyond the Minimum Data Sets (MDS) paradigm to an integrated suite of diagnostic indicators for anticipatory management of agro ecosystems.

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Ronnie Babigumira

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Daniel Müller, Institute of Agricultural Economics and Social Sciences, Humboldt University Berlin
Arild Angelsen, Department of Economics and Resource Management, Norwegian University of Life Sciences

Drivers of Land Use Change: Deforestation in Uganda

Disagreements characterize the discourse the drivers of deforestation, and various studies have produced rich arguments. Empirical evidence on the causes of deforestation continues, however, to be largely based on cross-national statistical analysis. In addition to the fact that this evidence is irresolute, the scale of analysis masks sub-national differences that may better explicate the linkages. In this paper we use a novel spatial approach to analyze deforestation in Uganda. We exploit geographic information systems (GIS) techniques to integrate highly disaggregated socio-economic statistics derived form a national census with spatially explicit biophysical and land-cover data derived from remote sensing. The paper is thus based on a new and comprehensive dataset, which is used to estimate an econometric model of drivers of deforestation in Uganda between 1990 and 2000. The 1990's were a decade of relative peace and economic prosperity in Uganda. Annual GDP growth averaged 7%, while population grew at 3%, implying an improvement in living standards with a substantial reduction in headcount poverty. These developments had implications for land use and the environment, and this dynamic context makes the study interesting and relevant. Finally, the scale of analysis gives the study high relevance, not least from a policy-making perspective. By integrating disaggregated socioeconomic drivers in the pixel-level analysis, we are able to identify key variables for land use decision makers like infrastructure, market access and poverty, which are relevant to the formulation and implementation of policies for more sustainable land use.

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Stijn Cleemput

University of Goettingen (GAUG)

Biomass Estimation of the Sustainable Charcoal Production and Licensing System Area in Masindi District, Uganda

Large parts of Uganda's industrial, service sectors and households are based on the utilization of charcoal for heating and cooking purposes. One of the main charcoal supply zone is situated in the Masindi district. As a main preference, the woodlands are favoured by the local community for charcoal burning, in order to protect these remaining woodfuel stocks the Ministry of Energy and Mineral Development of Uganda sponsored by the GTZ-EAP implements a taxation system that tries to control the flow of wood resources out of the district. This study aimed to assess the current standing stock of woody biomass. With the support of the former National Biomass Study of Uganda, following methodology was applied: after updating a historical landcover map of the nineties, with the help of a Landsat image of 2001, the study area was classified into 13 different landcoverclasses distributing 131 field plots over its area. In these plots 10811 trees were completely enumerated for total height, diameter at breast height, crown width and bole length. Aggregating the individual biomass for each tree, this data was used for the calculation of the standing stock per hectare for the classes which were most favoured for charcoal burning (grassland, woodland, bushland, subsistence farmland). Some of the resulting figures estimated that the woody biomass standing stock ranged from 7.73 tons per ha for subsistence farmland up to 43.19 tons per ha for woodland. Analysis of the updated Landcover showed significant differences for its area of woodlands. One of the results of this analysis was that over the last twelf years woodlands were decreasing at a rate of 5 ha per day, losing a total amount of 168,457 tonnes of air-dry wood per year in its most vulnerable parishes. Another conclusion was that most of this degradation was situated nearby road sides and within the higher accessible areas of the district.

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Woody Biomass Estimation of the Forested Land in Masindi District, Uganda

Large parts of Uganda's industrial, service sectors and households are based on the utilization of charcoal for heating and cooking purposes. One of the main charcoal supply zone is situated in the Masindi district. As a main preference, the woodlands are favoured by the local community for charcoal burning, in order to protect these remaining woodfuel stocks the Ministry of Energy and Mineral Development of Uganda sponsored by the GTZ-Energy Advisory Project implements energy saving activities in the district. This study aimed to assess the current standing stock of woody biomass. With the help of the former National Biomass Study of Uganda, following methodology was applied: the study area was classified into 13 different landcoverclasses distributing 131 field plots over its area. In these plots 10811 trees were completely enumerated. This data was used for the calculation of the standing stock per hectare for the classes which were most favoured for charcoal burning (grassland, woodland, bushland, subsistence farmland). Some of the resulting figures estimated that the woody biomass standing stock ranged from 7.73 tons per ha for subsistence farmland up to 43.19 tons per ha for woodland. Analysis of the updated Landcover showed significant differences for its area of woodlands. One of the results of this analysis was that over the last twelf years woodlands were decreasing at a rate of 5 ha per day, losing a total amount of 168,457 tonnes of air-dry wood per year in its most vulnerable parishes. Another conclusion was that most of this degradation was situated nearby road sides and within the higher accessible areas of the district.

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Rainforest Conversion - Consequences for Runoff and Nutrient Output in the Nopu Catchment (Central Sulawesi)

With the experimental Nopu catchment at the border of the Lore Lindu National Park in Central Sulawesi (Indonesia) long term changements of water and nutrient balances are analysed since 2001 for tropical rainforests. The research design allows the investigation of gradual land use change due to forest conversion by smallholders on hydrological processes and nutrient depletion within the catchment.

The catchment area is 2,3 km2 with an annual precipitation of approximately 2500 mm with typical equatorial rainfall regime. The elevation ranges from 600 m a.s.l. at the outlet to 1420 m a.s.l. at the upper part of the watershed. Three weirs represents different sub-catchments with natural forest (headwater catchment-weir III), middle-slope sub-catchment with ongoing slash&burn since 1999 for annual cultures (maize, maniok, beans) and cacao and the down-slope sub-catchment with cacao-agroforestry in the flat area of the village. Continuously water level, electric conductivity, pH, temperature and turbidity is measured, coupled with TDR-measurements on 29 soil profiles and three lysimeter stations for nutrient leaching. Water samples from the weirs are taken weekly and measured for several chemical parameters.

Being a mesoscale mountainous catchment the dynamic of the runoff is triggered by the precipitation and soil water content with very fast precipitation-runoff reaction and a wide range between low flow and high flow. In dry periods weir II shows a higher dry weather discharge (1 mm/d to 0,4 mm/d at weir III) because of higher storage capacity of the soils and lower evapotranspiration rates. The calculated ground water storage capacity in the catchment despite high storage capacity of the soils is low with 57,5 mm until 82,4 mm. The daily river discharge, low groundwater storage capacity and the discharge component separation (digital filter) indicates a fast runoff dynamic with an amount of 27-35 % for the quick direct runoff components (surface runoff, quick interflow). During floods, fast components contribute to 80% to the total runoff.

The water fluxes of the research area was modelled with the physically based water balance model WASIM-ETH. Using a “multiple response validation” approach (with runoff, soil moisture, separated runoff components) a good agreement between simulated and measured water balance was reached. Experimental measurements and modelling results shows for the increasing land

use (forest conversion) an increasing runoff and high increase of direct runoff components for the agriculture szenario (+ 82%).

With the forest conversion on relative fertile soils (eutric a. dystric Cambisols) the nutrient leaching and soluble nutrient output increases with significant differences between weir II and III for nearly all cations, PO4-P and N (in 2002 exception Ca) with high variation between main rainy season and lower precipitation times with base flow (concentration increase). Comparing 2002 and 2004 the nutrient concentrations in the river discharge at weir III are in the same level (partly slight increase). Opposed at weir II (increasing slash&burn area) the nutrient concentration increases between 2002 and 2004 for the main cations (Ca, Mg, Na) and nitrogen, whereas K and P shows a slight decrease. With the absolute values (nutrient output in kg/ha*a) sub-catchment II has a higher output for all nutrients with +33% (N) until +180% (Na) compared with the rainforest sub-catchment III. – With the detailed nutrient concentration analysis over time specific indicators for the relation of forest conversion and nutrient output are derived. Comparing the nutrient output from Nopu with other tropical catchments, the relative high amount is caused by good nutrient status of the soils, increase of mineralization with forest conversion and stronger vertical and lateral nutrient leaching to the Nopu river. Different output reactions exists for the biological-pedological ions N, PO4, K with highest output rates within the first and second year after forest conversion and the pedological-geological ions (Ca, Mg) with increasing output from the the first until fourth year.

Coupling the nutrient output analysis with the simulation of runoff (WASIM-szenarios), the future consequences for nutrient depletion in tropical mountainous catchments can be pointed out.

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Perception and Management of Water Resources in a Changing Tropical Rainforest Margin of Central Sulawesi, Indonesia

Water as an essential common pool resource is more and more focused in different disciplines around the world. As a part of the ecosystem and a resource for human nutrition water plays a major role in societies' organization and land use strategies. Even in humid tropical zones contemporary land use changes have an increasing impact on the water supply. Therefore further knowledge about utilization, perception and management of water is indispensable to a broader understanding of the cultural and natural landscape as a complex system. This study examines the human influences on perception and management of water on the basis of two sample villages.

The research was realized within the framework of the SFB 552 Stability of Rainforest Margins (STORMA) in the frontier zone of the Lore Lindu National Park in the province of Central Sulawesi in Indonesia. Quantitative and qualitative interviews were conducted in selected households of both villages. Based on the quantitative data from a household survey that was conducted in 2004 by our subproject A1 a detailed sub-survey was done additionally. Furthermore expert interviews were done within the villages as well as in the provincial capital city with national and international stakeholders. The main focus of the household interviews was on the perception, use and management of water. The expert interviews had a focus on an external view of intervening parties. This combination allows for a reliable interpretation of the data.

Perception: It is important to note that deforestation and land use are seen by the respondents as a main reason of changes in water quantity and quality. Deforestation is perceived as a direct cause of decreasing availability of water. This perception of the local people differs from results of natural sciences because the precipitation and runoff water measurements do not show the same correlation to deforestation processes as percept in the region. Anyhow, deforestation is, in general, increasing the runoff. Other perceptions conform to natural sciences' outcomes, for example increasing dirt in the water due to erosion in consequence of higher precipitation.

Management: Furthermore the findings show revealing differences between the two villages in water management structures. The main reasons for these differences can be put down on one hand to the factors migration and population

growth, on the other hand to external intervention (e.g. the community development program of CARE). In addition, differing spatial structures of water supply can be found within both villages, showing clear differences due to the households' location. There are for example great differences in the households' applied technologies (e.g. in the pipe material), though the same sources are used. The explanation for these differences originates in the individual households' socio-economic status.

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A Hierarchical Land Cover Classification Concept for Central Sulawesi, Indonesia

The tropical land cover, especially the extent of tropical forests and the rate of deforestation is of particular interest in environmental studies of any kind. The two major reasons for this are 1) greenhouse gas contributions (carbon fluxes) from tropical deforestation and regrowth and 2) loss of biodiversity from tropical deforestation and land cover conversion. The determination of exact and reliable deforestation rates plays an important role for any kind of spatially explicit model that aims at the estimation of one of these two factors.

Several efforts have been undertaken during the past years to map the forest cover in the tropics and monitor changes of forest cover. Besides the problem of accuracy assessment (calibration/validation) these studies lack the direct interoperability due to differences in class definitions. Another disadvantage of the recent global land cover maps (GLC2000, MODIS-IGBP) is the coarse resolution of 1 km2 / pixel. This restricts the minimum detectable area of change and leads to a significant loss of information especially in heterogeneous landscape patterns like those that are common in Southeast Asia.

The present study is part of a collaborative research about the spatially explicit assessment of the extent and changes in forest cover at the rainforest margin in Central Sulawesi, Indonesia. Within this context, a hierarchical land cover classification system is established that aims at the harmonization of existing and planned land cover maps at different spatial observation scales. The harmonization of land cover and land use information is an invaluable task for the concise mapping of landscapes, especially within interdisciplinary workgroups where sometimes a variety of definitions, nomenclatures and observational scales are used to describe and investigate similar landscape features (e.g. the land cover class “open forest” is interpreted differently in former and present maps, by locals and scientists, etc.). This inconsistency leads to misunderstandings and increases the uncertainty within land cover maps.

The current approach that is investigated within this study relies on a land cover classification system (LCCS) that has been established by the FAO as a fundament to construct a global land cover database and to harmonize existing multi-source information about land cover and land use. The land cover classification concept for Sulawesi, Indonesia (LCCS-Indonesia) uses the FAO-LCCS system as a

theoretical framework for the definition of hierarchical land cover classes. In a first step of data analysis, existing land cover and land use maps (satellite maps, topographic maps, local inventories, etc.) are integrated (translated) into a land cover database for the project area based on the hierarchical class concept. In the second of the classification concept involves the creation of updated spatially explicit land cover information from multi-source, multi-scale remote sensing data. The multi-scale satellite data classification concept is mainly based on the mapping of the fractional coverage of the dominating surface types (vegetation, soil, water) which allows the validation and upscaling of lower spatial resolution data from higher spatial resolution data (e.g. from MODIS, to Landsat to Quickbird).

Within the proposed presentation we will discuss the a.m. problems of land cover discrimination and we will demonstrate the framework of the land cover classification concept that is used within the SFB-552 (STORMA) in Central Sulawesi. The detailed concept of satellite data analysis (fractional surface coverage, upscaling approach) will be presented within an accompanying poster presentation (see Twele, A., Erasmi, S., Kappas, M.: A multitemporal spectral unmixing framework for physically based change analysis at the rainforest margin, proposed for poster presentation).

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Soil Differentiation and Soil Properties in the Submontane Rainforest of Central Sulawesi (Toro – Indonesia)

In the Toro intensive research area, a soil survey was conducted within the framework of the research progamme 552. It was the aim of the soil survey to analyse soil properties in land use catenas from the undisturbed rain forest to cocoa agroforestry plots and to identify relief controls on soils.

The research area is located at the edge of Lore Lindu NP near Toro with a submontane rain forest and an equatorial tropical climate. The area is part of the eastern edge of the Palu valley, which is a part of a large rift valley and recent seismic activity. Relief between 750 to 1000 m a.s.l. breaks down into flat valleys and basins (with rice cultures), steep (20 to 30°) concave slopes and ridges. Substrate for pedogenesis is not the metamorphic rock, but rather previously weathered saprolite.

In different relief positions as well as basin-ridge-slope catenas, we augered ca. 250 profiles and analyzed 24 profiles as follows: We determined texture, bulk density, pH, Ct, Nt, P2O5, ECEC, and base saturation and classified soils according to FAO.

Soil examinations show that soil differentiation is controlled by relief and frequent landslides. Autochthonous soils are characterised by deep (several m) chemical weathering, dominant ferralitisation, rubefaction, and clay illuviation. Allochthonous soils are, especially on slopes, characterised by a high skeleton content, and clay mineral alteration. Soils on older landslides show signs of beginning illuviation.

Thus, on ridges, soils enriched in sesquioxides with high clay content, strong acidification (pH 3.5), moderate contents of P2O5 and low ECEC dominate. These soils are Haplic Ferralols, and Ferric or Haplic Acrisols and Luvisols. Autochthonous profiles on slopes are also strongly acidic (pH 3.5 to 4.2), and have a low ECEC, low contents of P2O5 and illuviation dominates. Depending on slope position and degree of hydromorphy, Ferric or Haplic Acrisols or Luvisols, or Gleyi-Dystric Cambisols and Gleyic Acrisols occur. On footslopes, alluvial fans or colluvial sediments prevail. Therefore, soils are moderately acidic, and have 3 to 30% skeleton content. Soils are Gleyic Cambisols, Gleyic-cumulic Anthrosol, Umbric-cumulic Anthrosol.

Pedogenesis on slopes that are characterized by landslides can be differentiated

into old soil units that are more acidic, more clayey and illuviated and young soil units that are less acidic, of coarser texture, and less developed.

Consequently, soil potentials on catenas vary within small areas relating to slope development. Generally, autochthonous soil units are strongly acidified, and poor in nutrients, and prone to soil degradation when not used in a sustainable way.

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Simulating the Effect of Catchments Scale Land Use Change on Atmospheric Surface and Hydrological Parameters around the Lore Lindu National Park, Central Sulawesi, Indonesia

Increasing agriculture and residential land demand in Central Sulawesi has changed the atmosphere – earth surface interaction. Atmospheric parameters should, therefore, change too. The impact of land use changes from forest to agricultural crops and to residential areas on meteorological and hydrological parameters has been numerically modeled using the dynamic mesoscale atmospheric model MM5. Values in the surface parameterizations in the MM5 model were changed around the Lore Lindu National Park from the present land use patterns to the scenarios of a mainly rural region with annual and perennial crops and to a region with high residential areas. The values for shortwave albedo, long wave emission, roughness length, thermal surface heat capacity and field capacity for water storage changed therefore. The average daily maximum 2 meter air temperature and the planetary boundary layer height increase because of these land use changes. In general in these scenarios: the 2 meter air temperature increased by a few tenths Kelvin during the afternoon and early evening hours and decreased shortly before and after sun rise. During daytime mixing ratios of water vapor generally decreased; the Bowen ratio as the ratio of the vertical latent and sensible heat fluxes increased since the surface is less covered with dense vegetation so that incoming radiation is transferred more into sensible than latent heat. Cloud cover generally decreased as the boundary layer got drier. Surface runoff generally increased due to fact that the vegetation-soil layer could keep less water.The evapotranspiration decreased and more discharge was generated. Furthermore the recharge rate increased. The model runoff for the present situation was comparable to the measured water fluxes of the catchments.

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Soil Nutrient Balances at three Levels Increasing in Scale from Field to Land Use and the Farm: a Case Study in two Agriculturally Important Altitudinal Belts in Ethiopia

Nutrient balance can be made at different hierarchical levels of agricultural systems (e.g. field, farm, watershed, national and sub-continental scales). The present study reports detailed N, P and K balances for 10 case study farms in two contrasting altitudinal belts, the Dega (cool highlands) and Woina Dega (warm-to-cool mid-highlands) of the Central Highlands of Ethiopia. It also enlightens how the results from these detailed field and farm scale analysis help to explain the nutrient balance studies at higher spatial (i.e. watershed, regional and national) scales. Two watersheds representing the altitudinal belts were selected as study sites. Farm inventory, monitoring and interviewing were used to collect information on farm management practices. Soil samples and material flows (e.g. manure, harvest, residues, grass and etc.) were collected and analyzed for nutrients concentration. We mapped the case study farms' fields by Geographical Positioning System (GPS) and superimposed on Digital Elevation Model (DEM) of the two watersheds to group the plots into different landscape positions. In addition to plots and farm scales, balances were also calculated for each landscape position.

Our results show that natural conditions (e.g. location of plots in the landscape), choice of crop, access to resources (e.g. land and livestock) and smallholders' source of income influence the path and magnitude of nutrient balances. In Dega strongly negative N and K balances were calculated for potato (Solanum tuberosum; grown at the homestead), meadow and cereal fields, while enset (Ensete ventricosum; grown at the homestead) had positive balances of N and P. In Woina Dega, the results showed strong depletion on almost all fields. Nutrient balances for different landscape positions showed also contrasting results. In Dega, fields on foot slope were strongly depleted than those on the upper and mid slopes. In Woina Dega P depletion was lower on the foot slopes. Differences in land use (on foot slope) may account for those discrepancies. Our results contrast with higher spatial scale studies (i.e. national, regional and zonal scales) which invariably show that homestead fields are zone of accumulation and distant fields as zone of depletion. We conclude that the reason for contrasting nutrient balances at different scales can be explained by the focus on arable land in national scale studies, while potential areas where nutrients may accumulate are not considered.

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Are Rubber Agroforests in Sumatra Dependent on Stable Forest Margins for their Survival?

Traditional rubber agroforests provide a suitable alternative habitat for many forest plant and animal species. In the Eastern lowlands of Sumatra, the strategic importance of rubber agroforests as a refugium for forest species cannot be underplayed in the face of rapid forest exhaustion.

The role in biodiversity conservation that rubber agroforests may play however is tightly dependent on their spatial extent. In an attempt to assess current trends in land use changes, we analysed the land-cover changes in a ca. 4,500 km2 area, representative of the peneplain-piedmont landscape dynamics in Eastern Sumatra (Bungo district, Jambi province). The analysis is based on a series of satellite images covering the 1973-2002 period.

The natural forest area decreased from ca. 75% in 1973 to ca. 34% in 2002; during the same period, rubber agroforest area decreased from ca. 16% to ca. 12%. Natural forest and rubber agroforests have been converted mainly to pure rubber plantations (which increased from 3% of the district area in 1973 to 28% in 2002) and oil palm plantations (from none in 1973 to 12% of the district area in 2002)).

While the natural forest conversion rate has been quite constant since the early 1980's (ca. 3% per year), rubber agroforest conversion rate shows a clear increase since the early 1990's (from 0.3% per year in the 1973-1988 period to more than 4% per year in the 1999-2002 period).

More importantly, the analysis shows contrasted trends in rubber agroforests land cover dynamics over the studied area. Trends are apparently not independent of forest conversion dynamics: rubber agroforests were maintained only in areas where the forest margin was stable; their area strongly decreased where the forest margin encountered a fast retreat, up to an almost complete disappearance in areas with no forest left.

The probable causes of those contrasted dynamics are discussed, as well as some of their consequences with regard to the potential role of rubber agroforests in biodiversity conservation strategies for Sumatra.

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Deforestation Bow Waves in the Central Peruvian Amazon

This paper describes patterns and processes of deforestation in the Central Peruvian Amazon between 1950 and 2000. The research combines observations of land cover patterns from remotely sensed data with analysis of census information at the village level. The paper briefly reviews the literature on making inferences about deforestation processes from the spatial pattern of land cover. In the Central Peruvian Amazon, deforestation patterns were mapped at different times over a 50-year period. A map showing the periods when different areas of the region were deforested suggests a land cover change pattern analogous to a boat's bow wave. Deforestation proceeds outward from urban settlements along roads, and perpendicular to roads. This movement of the forest margin results in land cover patterns resembling pyramids or triangles. Over time the pattern resembles a boat's bow wave as it move across the water. Socioeconomic conditions vary depending on where a village is located in the larger land use pattern. Villages in areas deforested long ago are characterized by more intensive agriculture, larger farm sizes, more livestock operations, greater social capital and higher levels of well-being. Villages at the forest margins have greater poverty and less intensive agriculture. The forest margins are not uniform, but differ according to spatial and temporal position on the landscape. Research and development in the forest margins must respond to different opportunities and constraints relative to the development continuum.

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Impact of Cloud Precipitation on the Water Budget in Tropical Cloud Forest Ecosystems

Forest structure and climate conditions have been investigated for seven 10m x 50m plots along a transect at the continental divide in the Monteverde Cloud Forest Reserve, Costa Rica between April 2003 and March 2004. Climate stations (measuring horizontal precipitation, rainfall, throughfall, temperature and soil water content) were installed along an altitude range from 1500m asl at the ridge top, to 1200m asl, including the windward (Atlantic) and the leeward (Pacific) slope. The results show important differences in forest stature and hydrology between the investigation sites. Annual rainfall varies from over 7000 mm on the trade wind – exposed Atlantic slope to 4130 mm on the Pacific side, which is more influenced by the dry season from January to mid May. Horizontal precipitation (clouds, fog and wind – driven rain) can be an important input, especially during the dry season months. It reaches its maximum at the ridge top, which is also reflected by the throughfall measurements. On the most wind - exposed sites between the upper Atlantic slope above 1300 m asl and the ridge top, precipitation inside the forest was 12% higher than the rainfall above the canopy. On the leeward slope of the transect, however, throughfall reaches less than 70 %, due to interception losses.

Investigating the relationships between forest stature and different precipitation types, it becomes clear, that additional hydrological inputs in the exposed cloud forest types of the area can directly be linked to canopy features. Throughfall amounts can be estimated for the subplots, where they usually exceeded outside precipitation, from rainfall, horizontal precipitation and crown surface area of the 50 % highest trees.

This suggests, especially for the very exposed, (potential) cloud forest zones, that landuse forms, which maintain a tree cover, e. g. conservation, sustainable use of secondary forest, agroforestry, can help to secure hydrological ecosystem benefits for agriculture, hydroelectricity and drinking water in regions further below.

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Carbon, Water and Energy Fluxes between an Upland Tropical Rain Forest and the Atmosphere in Central Sulawesi, Indonesia.

One major concern about land use change and sustainable land use is its potential feedback to local water resources and both local and global climate. To evaluate such feedbacks the atmospheric exchange of greenhouse gasses, water vapour and energy have to be described for the rain forest and its future substitutes. Until recently, field data on these transport processes in major South East Asian ecosystems were lacking entirely, and, thus, modelling of land use change effects was in danger to stay only a vague computational exercise.

As part of the interdisciplinary research on the Stability of Tropical Rain Forest Margin Areas (STORMA) in Central Sulawesi, Indonesia, we investigated the atmospheric energy, water and carbon dioxide transports above an upland tropical rain forest in the Lore Lindu National Park. Gas fluxes were measured continuously over more than one year with the eddy correlation technique from a 70 m high scaffolding tower. In addition, meteorological variables were measured and used to characterise both the physical environment that affected the fluxes and important optical properties of the forest canopy.

Preliminary evaluations showed that the upland rain forest took up carbon dioxide at an unexpectedly large rate. However, local microclimatic effects at night and technical effects of the open path gas analyser had to be considered in order to compute corrected annual carbon dioxide budgets.

Water and energy exchange differed both from a previously investigated cacao agro forestry system and from other rain forest sites that have been investigated in South America. According to lower short wave reflectance (albedo) the tropical rain forest absorbed more radiant energy than, e.g., the cacao agro forestry system under similar weather conditions. However, sensible heat production was less due to higher evaporation rates.

Our results showed that a simple direct transfer from existing field data from tropical rain forests in South America to the situation in South East Asia is not reasonable, at least for the investigated forest. Longer flux observation and intensive ecophysiological investigation will help to unravel the reasons for the

observed biophysical functioning. From these data we aim to derive defensible model parameter values for land use change modelling in South East Asia that is based on scientific facts rather than on scientific assumptions.

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Development of Mechanistic Model for CO2 absorption of Forest Vegetation: Study case Lore Lindu National Park

Modelling the daily net absorption of carbon over a vegetated surface, with NPP as its major outputs has become a challenging research area at the present time. Process based modelling simulates biological processes controlling NPP such as photosynthesis, respiration and transpiration. They should be more reliable because they are based on our understanding of processes, hence they can be used for any site and vegetation type with the right input of parameters.

Net Primary Production, NPP, is one of the most important variable characterizing the performance of an ecosystem. It is the difference between the total carbon uptake from the air through photosynthesis and the carbon loss due to respiration by living plants. Standard field measurements of NPP at the moment are time-consuming and expensive and therefore not useful for obtaining NPP estimates over large areas. By combining the remote sensing and GIS technology and modelling, we can estimate NPP of a large ecosystem with a little ease.

This paper discusses the use of a process based physiological sun-shade canopy models in estimating NPP of Lore Lindu National Park (LLNP). The discussion includes on how to parameterize the models and how to scale up from leaf to the canopy. The application software documented in this paper is called NetPro v 1.0 (June, 2005), which is a potential NPP model where water effect is not included yet. The model integrates the use of Remote Sensing, Geographical Information System (GIS) and mechanistic modelling, and written using Visual Basic 6.0 programming language and MapObjects 2.1. The output of the mechanistic modelling is radiation use efficiency (e) at different [CO2], temperature and nitrogen level. Analysis of remote sensing data give Normalized Difference Vegetation Index (NDVI) and related Leaf Area Index (LAI) and fraction of absorbed Photosynthetically Active Radiation (fAPAR). NPP is then calculated using the above variables and climate data obtained from the network of meteorological station around LLNP, with the following equation: NPP=SUM(1-365) e.fAPAR.PAR

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Linking Physical, Economic and Institutional Constrains of Land Use Change and Forest Conservation in the Hills of Nepal

Forestlands have important functions from an ecological perspective and provide services that are essential to maintain the life-support system. Water supply and regulation, nutrient cycling are only some examples of the services that forestlands provide. The forests of mountains not only supports of residents in the regions but also much more people residing downhill side. However, expansions of agricultural land at the cost of lost of forestland are common phenomenon in the mountain zones of developing countries. Many studies have been conducted to demonstrate the land use change in the mountains. However, knowledge of changes, driving forces and implications of change linking with physical, economic and institutional context is limited. This study analyses the changes in spatial patterns of agricultural land use during the 1976–2000 period along the altitudinal gradients in a watershed in Nepal. The approach adopted here is to begin by examining the degree to which patterns of agricultural conversion can be attributed to a set of factors that have been identified as significant at broader scales in Nepal and elsewhere, namely topography, prior land use patterns, socioeconomic condition and institution governing access to land. Using information of land use derived from satellite images from 1976, 1990 and 2000, we examine the land change pattern. During the 1976–2000 period, agricultural land use increased by 35% at the cost of loss of forestland. Agricultural expansion was most conspicuous at higher elevations (1150–2000 m). About 43%, 37% and 22% of forestlands were converted into agricultural activities from higher, middle and lower elevation respectively. This could be due to the unequal focus on community forestry activities that are expected to have positive influences on the balance of the forest cover in the watershed. In addition, some other limiting factors such as socio-economic condition of farmers caused these changes in land management practices and the resulting land use patterns. Results of spatial distribution of living standard parameters including farm family income, food availability, obtained from family survey, shows the decreasing trend as the elevation increases whereas percentage of food bought shows increasing trend. In this way it was found that, forests lost were smaller that were located around high-income areas with good quality of agricultural land and near by administrative centre compared to areas located around low-income areas with low quality of agricultural land and far from the administrative centre. Finally, A regression model is constructed, for linking the socioeconomic condition with the conversion of forestland into agricultural activities, breaking the study area into smaller zones. The spatial trajectories of these zones are then contrasted, with particular attention to the socioeconomic condition and institutional arrangements

governing access to land resources. The study finds that while overall land change patterns in the region are largely explained by elevation and socioeconomic condition of people living adjacent to the forestland, more specific, sub-regional, trajectories reflect the signatures of institutions governing access to land. As sustainability of watershed is dependent on forests, continued depletion of forest resources will result in poor economic returns from agriculture to local people together with loss of ecosystem services. Thus, for achieving the goal of watershed development, remaining forest land are to be kept under strict protection and for this policy support for technologies enhancing agricultural productivity, crop diversity, and efficient resource recycling within agro-ecosystems through soil and water conservation activities and the equal focus of community forestry program and effective forest monitoring across the watershed is needed.

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The impact of Lacking Household Drought Resilience on Forest Resources: The Case of Central Sulawesi, Indonesia

Crop production in the tropics is subject to considerable climate variability which is often attributable to the El Niño-Southern Oscillation (ENSO) phenomenon. The severe droughts caused by ENSO events in the 1990s have raised increasing awareness among scientists, the general public and policy makers concerning the impact of climate variability on natural resource management and food security in the affected countries. Furthermore, there is evidence that, in concert with global warming, the frequency and severity of ENSO events will increase during the 21st century. Little is known about the impact of ENSO-related drought on the welfare of the affected farm households, and about the impact of the households' drought-related coping strategies on forest resources. This paper seeks to contribute to closing this important knowledge gap with a case study from a rainforest area in Central Sulawesi, Indonesia.

Despite the proximity of farms to the rainforest of the Lore Lindu National Park, farmers in the research area face a substantial risk of drought. Most farmers do not have access to ENSO warning systems, and the level of farmers' preparedness for drought is generally low. Household risk management is mostly confined to ex-post coping strategies, notably the collection and sale of rattan from the adjacent National Park; this implies negative consequences for the biodiversity of the forest resources, and it shows that farm households may resort to illegal activities in order to cope with depressed agricultural income due to drought. Most of the affected households were forced to substantially reduce expenditures for food and other basic necessities. The drastic cuts in food expenditures are particularly alarming, suggesting that ENSO-related drought seriously impairs the food security status of farm households.

Apart from these descriptive survey results, the main objective of this paper is to measure household resilience towards drought and to identify its influencing factors in order to deduce policy implications. We argue that improved drought resilience would contribute to the conservation of forest resources by enabling households to refrain from environmentally unsustainable coping measures. The analysis is based on recently developed conceptual frameworks and presents a new method of measuring drought resilience as a complex social variable. Using indicators for consumption expenditures, we construct an index measuring household drought resilience via Principal Component Analysis. We then apply an

asset-based livelihood framework to identify determinants of resilience using a Tobit regression model. We find that the households' drought resilience is positively influenced by the possession of liquid assets and access to credit. Furthermore, technical efficiency in agricultural production is a resilience enhancing factor.

The results suggest a number of policy recommendations, namely improvement of the farmers' access to ENSO forecasts, the provision of credit and savings products facilitating consumption smoothing, and the intensification of agricultural extension in view of the low levels of technical efficiency found in the case of the cultivation of cocoa, the primary cash crop in the area.

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Is there a Potential to Reduce Deforestation by Improving the Technical Efficiency of Crop Production in Forest Margin Areas? Evidence from Central Sulawesi, Indonesia

The establishment of perennial crop plantations contributes considerably to the loss of tropical forests. Taking the case of cocoa production in Central Sulawesi, Indonesia, as an example, this paper investigates whether there is a potential for reducing deforestation by improving the technical efficiency of perennial crop production in rainforest margin areas. Using separate stochastic frontier production functions for comparison, we estimate technical efficiencies in the cultivation of cocoa, a relatively new crop in the research area, and irrigated rice which has been grown for generations. The levels of technical efficiency and efficiency determinants are estimated in a one-step procedure. The estimated mean technical efficiency of rice production is 77%, while that of cocoa, the most important cash crop in the area, is merely 37%; this indicates that there is a large potential for increasing cocoa production through improved management of the already existing plantations, i.e., without converting additional forest land. The analysis of the determinants of technical efficiency shows that poverty and illiteracy have an efficiency reducing effect in both rice and cocoa production. Extension services significantly increase the technical efficiency of rice cultivation, while this effect is not observed in cocoa production. Older farmers are more efficient than younger farmers in rice production, while the opposite is the case in cocoa production. Acknowledging that increased productivity may also create incentives for deforestation, we conclude that the comparatively low technical efficiency in cocoa cultivation indicates a considerable potential for reduced deforestation by increasing farm income on already converted forest land. Our results indicate that policy interventions aimed at realizing this potential should include improved agricultural extension focusing on technical advice concerning the management of cocoa.

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"Knowledge" as Cultural Impact Factor for Land Use Change - Findings from Central Sulawesi, Indonesia

To ensure the stability of a habitat it is important to understand the cultural driving forces that influence people's decisions on land use. Knowledge is a crucial component of these forces, which determines actions and decision-making processes. Every individual person has different capacities and possibilities to accumulate knowledge and it is gained in different ways. So, the aim of this study is to identify the role of knowledge attained by school education, traditional transfers and experiences. In addition, the cognition of the environment, concerning biodiversity as well as environmental benefits, is a central focus of the study.

Within the framework of STORMA (Stability of Rainforest Margins in Indonesia), the impact of these factors on land use decisions was examined in two villages in the vicinity of Lore Lindu National Park. Based on the analysis of topic related data of the A1-household census, qualitative semi-structured interviews with selected households as well as with key informants in the villages have been carried out. Furthermore, interviews with representatives of mass media and consultant agencies ensued results on external information sources and their diffusion.

Knowledge accumulation is used to assure alimentation and income generation. The planting of market products prove to be the strongest motive for land use change. In the economic context the findings show that the decisions on land use are not individual; they are much more linked to structures of social relationships. Family members and neighbors are the most important sources for information, innovation and decision-making processes. No significant correlation between the level of school education and land use change could be observed. However, higher education leads to a better access to information and innovation attendance. The perception of the environment is mainly based on economic interests, but traditional values have still a big impact. Knowledge on biological processes concerning the direct environment (e.g. paddy or agro-forestry plots) is widely unknown.

Furthermore the comparative study shows that social interaction and traditional values provide better information flows and a strong adherence to community interests. In this context key persons play an important role for information flows by organizing groups, which can, for instance, provide a sustainable management of agro-forestry systems. The importance of individual knowledge accumulation

outside of the school education increases when the social interaction within a village is low. Particularly in this case, the influence of information sources from outside the village (private consultancy agencies, NGOs) increases. This phenomenon can lead to less sustainable land use due to a lack of local knowledge.

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Developing Local Systems for Establishing and Operationalising Land-Use Models for Tropical Forests

Planning, developing and establishing functional and sustainable land-use planning for tropical forests, essentiates a comprehensive and integrated approach. These land-use models have to be specific to the site specific conditions of the resources and the associated local demands. Establishing a sustainable land management system involves comprehensive inputs at the planning, establishing and operationalising phases. Considering the fact the almost 60% of the population still depend on the forests (especially in the tropical countries) for their live-support systems; it's important that the processes towards establishing a land-use management system should follow a participatory approach since the very initiation i.e. from the planning phase. At the planning phase amalgamation of various interests and needs of all the stakeholders is a pre-requisite. Thus, creating a common platform for sharing and exchange of information to accommodate varied needs and demands is an imperative. Further, during the establishing phase it's necessary that the required capacities are developed and suitable institutional arrangements and systems put in place. To ensure the sustainability of the models, it's quintessential that these models are adapted according to changes in the site-specific local resources and demands. This would be ensured by establishing a regular feedback mechanism in place i.e. a local participatory monitoring and assessment system that would provide periodic inputs to the communities on the needed adaptations to the developed land-use models.

The paper discusses the processes and practical methodologies for participatory planning, monitoring and assessment of a model that would be based on the local site-specific conditions and local requirements i.e. ecological, social and economic. It details the process, tools and inputs to develop local monitoring and assessment mechanisms that would ensure the suitability and adaptability of the models thus its sustainability. The paper also discusses processes for developing and enhancing local capacities for planning, monitoring, assessment and operationalisation phases. This paper is based on practical examples and is extracted from authors' experiences during operationalising community-based local monitoring and assessment systems for forest resources in India.

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STORMA-Lab Z3 - Introducing a Laboratory in the Tropics

In 2000, the research a laboratory for soil-, plant-, and water samples was erected in Palu (Central Su-lawesi, Indonesia). The laboratory was set up within the framework of the research programme 552, which is funded by the Deutsche Forschungsgemeinschaft (DFG). The main task of the laboratory is the analysis of environmental samples close to the rain forest margin. So, time consuming transport by ship and airplane and resulting artefacts due to physical and biochemical transformations in the sam-ples can be minimised.

The laboratory cooperates with scientists of the local Tadulako University (UNTAD) and is embedded in its structure. Exchange with scientists from UNTAD takes place beyond project borders. Another task is the education of laboratory staff. So far, four Indonesian laboratory technicians with differing educational backgrounds were instructed. Quality assurance is safeguarded by routine analysis of standards in Göttingen and Palu.

The laboratory is equipped with a ICP-OES (Optima 2000 DV, Perkin Elmer) for cation analysis, a Continuous Flow-Analyzer (AA3, Bran & Lübbe) for determination of nitrate, ammonium, phosphate and chloride, an elementary analyzer for the analysis of carbon and nitrogen in solid samples and a TOC analyzer (Dimatoc 100, Dimatec) for determination of dissolved organic and inorganic carbon and total bound nitrogen in aqueous samples. Continuous power supply is safeguarded by a 100 kVA diesel emergency backup generator and a 40 kVA USV- installation.

The laboratory characterises soil-, plant-, and water samples for their micro- and macro nutrient con-tent. Analyses of trace elements can be carried out, but are conducted just for essential trace nutrients within the project. Scientists from UNTAD also determine heavy metals. Consulting on field sampling and adapted analytical procedures is also part of the Z3 project.

In 2004, 5246 samples belonging to 176 orders were analysed. In order to safeguard a rapid and smooth sample flow, an adapted system of sample logistics was combined with an extensive data-base. The client completes a form that lists possible analyses and costs. Then, samples are analysed, stored in the database, numbered and provided with results of the analyses. Finally, clients receive the results via email or other digital data storage devices. Data is stored weekly on a

central work station.

In the tropics, supply with water that meets analytical requirements (i.e. absence of ionic, bacterial and particular contamination) is often difficult. In order to comply with standards, condensate from air con-ditioning is collected and purified with a multi-stage water treatment device: Reverse Osmosis RO6 plus by Werner, Cation exchange and UV combustion using a Easypure UV instrument by Barnstead. The device attains a pureness of 18 MOhm cm-1 and <1µS.

Laboratory waste is treated by neutralisation of aqueous samples and detachment of heavy metals by an electrochemical voltage sequence.

Besides laboratory routines, soils in the research area of the research programme were mapped and characterized in the laboratory. In addition to the field trials, several small experiments in Nopu (ex-perimental catchment) and Bariri (micrometerological tower) on nutrient leaching in soils were carried out.

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A Multi-Agent Simulation Model of Land-Use and Land-Cover Change for an Upland Watershed in the Central Coast of Vietnam

Land-use and land-cover change (LUCC) is an essential environmental process that should be monitored and projected to provide a basis for assessing alternatives for better land management policy. However, studies on LUCC processes are often challenged by the complex nature and unexpected behaviour of both human drivers and natural constraints. A multi-agent simulation model (VN-LUDAS - VietNam – Land Use DynAmics Simulator) has been developed to model interdependencies and feedback mechanisms between human agents and their environment. The aim of developing the model is to explore alternative policy scenarios to improve rural livelihoods and the environment, thereby providing stakeholders with support for making more informed decisions about land resources management.

The VN-LUDAS model consists of four modules that represent main components of the coupled human-landscape system in forest margins. The human module defines specific behavioural patterns of farm households (i.e., human agents) in land-use decision-making, according to typological livelihood groups. The landscape module characterizes individual land patches (i.e., landscape agents) with multiple attributes, representing the dynamics of crop and forest yields and land-use/cover transitions in response to both household behaviour and natural constraints. The policy module represents public policy factors that are assumed to be important for land-use choices. The decision-making module integrates household, environmental and policy information into land-use decisions. In the first development of the model, we nested the bounded-rational approach based on utility maximization using spatial multinomial logistic functions with the heuristic rule-based techniques to represent decision-making mechanisms of households on land use. The proposed agent-based architecture allows integration of diverse human, environmental and policy-related factors into farmers' decision-making on land use, and projection of subsequent accumulated outcomes in terms of spatiotemporally explicit patterns of the natural landscape and population. Although many features of the complex processes of human decision-making have not been included yet, the agent-based system has built-in flexibility for adapting, upgrading and modifications.

The developed model was applied to an upland watershed of about 100 km2 in the A-Luoi district of the Central Coast of Vietnam. Spatially explicit data were

obtained from Landsat ETM images, thematic maps, extensive forest inventory and intensive household surveys. Field data were used for calibrating the behavioural parameters of households and land patches, and to develop an initial database for simulations. Considered policy factors were watershed forest protection zoning, agricultural extension and agrochemical subsidy. The model can potentially serve as a consistent tool to provide quick and relevant feedbacks in a form that allows stakeholders to revise and retest their ideas of policy interventions. Simulation outputs are spatiotemporally explicit, including multi-temporal land-use/cover maps of the landscape environment and basic socio-economic indices of the community at different aggregate levels of human/landscape agents. This enables efficient communications with various stakeholders in land-use planning and management.

Preliminary simulation results for 10 different policy options suggest that reducing the current proportion of protected area from 90 % to 50 % and increasing the enforcement of protection, together with provision of extension services for a third of the total population, and subsidizing 5 % of the population with agrochemicals ($ US 16 /hh/yr) will, on average, increase per capita gross income by 15 % and significantly reduce forest degradation compared to the current scenario (i.e., the policy setting in 2002). The simulated spatiotemporal data can be used for further analyses using standard GIS (Geographic Information System) and statistical packages.

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Water Resources Conservation in the Tropics: Assessment of Natural Resources and Socio-Economic Features, Bulaba Sub-Basin, Central Panama

One of the main priorities of Panamanian Environmental Law (ANAM, 1998) is the protection, conservation and management of upland watersheds. Goal of this law is to maintain the natural water resources for future generations. To fulfill this goal, management plans have to be developed based on an assessment of the natural, social cultural and economical features of each watershed. Important is the participation of all stakeholders (e.g. public institutions, local watershed committees) in the surveys and plan development.

Based on this framework, an assessment of the Bulaba watershed was conducted. The Bulaba River is part of the Santa Maria River Watershed, which is one of the most important watersheds in Central Panama. This Bulaba sub-basin is part of the Talamanca Forest Eco-region. This region is considered as a global hot spot for biodiversity (ANAM 2000; Angehr, G.O 1998). The Bulaba river sub-basin, contributes the highest volume of water per square kilometer to the Santa Maria river watershed. According to UNDP-Panama (2002), the human developed index for this area is one of the lowest in the country. Most of the Bulaba area is part of the Santa Fe National Park (established in 2001). The park was created principally to maintain the remaining forests and for the conservation of water resources. The settlement in this region dated from 1558, when Spanish colonists founded the Santa Fe village. The motivation for this colonization was the exploitation of gold mines.

We compiled information on the natural features of study area (meteorological data, historic documents, maps, aerial photos, etc). Local people provided information on former land-use, ancient knowledge regarding the use of natural resources and legal aspects of the land tenure. Maps on the delimitation of the sub-basin, hydrographic features, forest cover, relief, roads, villages, life zones, soils, administrative division were generated using Arc View GIS v3.2.

The preliminary results indicate that the sub-basin has been colonized principally since 1850 in the southeast agree with the most deforested area. The total area of the sub-basin was calculated in 84.56 Km2. The major actual forest cover is only existent within the limits of the Santa Fe National Park which covers 66% the sub-basin. For 1982 the forest cover represented 71.74% and shrubs/pasture was 28.26%.

In 2000, there were 18 villages with 582 inhabitants, this population is stable for

2004. Although the local population was decreasing in the last 15 years, there is an increase in urban sprawl because of moving in of foreign people. Subsistence agriculture is the principal source of income (corn, cassava, coffee and fruit trees) developed in soils with high slopes. The principal local soil management used is the slash and burn, joined with a mean of three years of unimproved land period. It is already observed that ENSO events have an impact on the water fluxes in the river, although the existent of the remaining cloud forest was thought to minimize the impact. The highest volumes of water treated for human supply in Santa Fe village, occurring during the dry season (December to April) with scarcity verified in any sectors.

One conclusion of our assessment is that it is necessary to enhance the local knowledge related to the values of the sub-basin in terms of global (biodiversity, carbon sequestration) and local (livelihoods, water supply, mitigate the climate change) aspects. Further, it is important to incorporate the government and private sector in the process.

The natural values (landscapes, flora and fauna) have the potential for the ecotourism but it is necessary to regulate the use of natural resources and colonization through local planning (e.g. the planned projects of hydroelectric generation, logging for houses constructions).

Further studies have to be conducted to gain information on: (a) hydrologic dynamics of the local mountain cloud forests, (b) local uses of woody species, (c) carbon sink potential and (d) valuation of local uses of forest diversity (e) validation of agricultural techniques for soil conservation. We further recommend a joint management of Santa Fe National Park and capacity building for watershed management.

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Hydrology and Suspended Load Research in Nopu Catchment in Central Sulawesi Indonesia

Suspended load is one parameter mostly occur during the hydrological event such as rain as a function of several physical conditions; topographical (slope), soil property land covering and crop management. This strong association can be well performed in a small rainforest catchment in which human interference is taking place.

Nopu watershed is one of the interesting location to conduct such research that fulfill all of the criterion needed to understand the influence of hydrological significance to the process of erosion and suspended load generation. It is situated at the border of Lore Lindu National Park in Central Sulawesi Indonesia, with an area of about 2.5 km2, lay at the altitude of 280m a.s.l. at the outlet of the watershed to the highest elevation of about 1420m a.s.l resulting very steep slope at the upper part of the basin. The annual rainfall intensity is app. 2500 mm/year.

There are three weirs at the outlet of each river-scheme represented land use system are constructed. Our main concern is doing investigation at weir 2 and 3 since they represent the slash and burn and natural rainforest sub-catchment respectively. In order to understand good relation between hydrological processes and suspended load in a small rainforest watershed, a number of measurement devices are installed in the research area. The most important data were gathered directly are turbidity in relation to the discharge and total suspended sediment in respective time.

Purpose of the study is to foresee the effect of hydrological circumstance in the basin to the quantity and quality of suspended sediment that recorded and analyzed in temporal and spatial basis. Additionally, the event base of the quantity of the suspended sediment and its texture were taken.

Result shows that the hydrology event by means of precipitation (intensity and duration) play as a main factor of the suspended sediment generation in the Nopu catchment. With the rainfall intensity of 4mm/10 minutes leads to higher water level to 20 cm (0.10 m3/sec.) and turbidity value was 181.5 NTU at weir 2 whereas in weir 3 was 10 cm (0.02 m3/sec.) and turbidity was 18.5 NTU. Obviously that the other parameter such as type of soils, slope, land covering as well as crop management are factors play remarkably important in understanding the erosion process trigger the suspension in the stream. With the correlation of turbidity and suspended load the suspended sediment output will be estimated with the consequences for water quality (water use by village people) and nutrient-

, mainly carbon loss from the upper soils of the catchment. In terms of sediment texture, higher percentage of the coarser particles (> 5 μm) of suspended load from weir 2 was specified in comparison with one from weir 1.

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Rainforest Conversion and Suspended Load in a Small Rainforest Catchment in Central Sulawesi

Suspended load plays a significant role in comprehending the effect of forest conversion on the catchment scale. Due to forest conversion in a small rainforest basin in Central Sulawesi, soil erosion occurs and surface runoff increases during events. Water turbidity is a good indicator for investigating changes in land use patterns.

The investigation area is located in the humid tropics with an annual rainfall of app. 2500 mm. The upstream part of the catchment is situated in the protected area of Lore Lindu National Park with sub-mountain rainforest. The Nopu-catchment area (2.45 km2) is divided into three sections representing different land use types: cocoa agro-forestry downstream, slash and burn in the middle and natural forest upstream. The elevation ranges between 580m a.s.l at the basin outlet and app.1420m a.s.l at the summit. Located near the equator, there is no clear distinction between rainy and dry season with a slight maximum during December until May. This pattern is a consequence of a northern and southern monsoonal rainfall regime within a mountainous region.

The purpose of the study is to investigate the effect of rainforest conversion on soil erosion processes and suspended load in the Nopu-catchment. With the nested catchment approach the main parameter runoff, turbidity and suspended sediment concentration (SSC) are compared between two land use systems representing natural forest at the upper catchment and a slash and burn subcatchment downstream.

To grasp the precise relation of the flood events and suspended load in the catchment, an automatic water sampler has been installed since October 2004 at the weir 2. Further a multi-parameter sensor to measure water level (mWS), turbidity (NTU) and electrical conductivity was installed at weirs 2 and 3 in the end of 2001. Manual sampling of sediment concentration at weir 3 is done weekly and event based (flood events) since 2002.

It was shown that turbidity and suspended load concentration as a function of surface runoff in Nopu were mainly affected by the condition of the land cover and land use activity within the sub-catchment of the weir 2. Comparing the rain events, which cause slight floods, between weir 2 and 3, in general higher suspended load concentration exists at weir 2 by 1.4 to 1.5 times than one at weir 3.

The result for total runoff between 2002 and 2004 and weir 2 and 3 shows,

despite lower rainfall in 2004, an increase in runoff of about 220mm at weir 2, which is a result of the ongoing slash and burn in this sub-catchment. During the floods event in 2004 the highest discharge at weir 2 was 1.821m3/sec (h=0.529m) with a turbidity value of 962 NTU. The minimum value was Q = 0.0187 m3/sec (h=0.04m) with 0 NTU in turbidity. At the same time in weir 3, the maximum discharge was 0.440 m3/sec (h= 0.384 m) and a turbidity value of 515.5 NTU (minimum was Q = 0.0015m3/sec or h= 0.008m and 0 in turbidity). For flood events, an average turbidity values shows that higher value occurs at weir 2 by 69.61 NTU in 2002 and 27.36 NTU in 2004 whereas at weir 3 were 30.28 NTU in 2002 and 15.31 NTU in 2004.

First correlations had been calculated for suspended load output in the catchment. The correlation of suspended sediment concentration (SSC, in gl-1) and turbidity (NTU) at weir 2 were derived:

Weir 2: SSC = 0.1981(NTU/100) + 0.1887, r2 = 0.5423

Weir 3: SSC = 0.0893(NTU/100)2 - 0.0473(NTU/100) + 0.0083, r2 = 0.7783.

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Determination of Imperata Grassland Dynamics in Cultivated Rainforest Margins - A Remote Sensing Based Approach

The progressive process of forest land conversion manifests itself in diverse ecological and socio-economic changes. One of the clearest examples of forest land conversion is the replacement of these forests by invasive grassy weeds (Potter 1997). The process starts when forests are utilized for timber purposes and remaining vegetation is cleared away for agricultural use, employing unsustainable forms of management. The process progresses when the soil becomes depleted of nutrients and the area is infested with persistent weeds. This practice is particularly prevalent when the farmers are not able to cope with the persistent weeds and continued cultivation no longer provides sufficient economic returns.

In Southeast Asia, the most infamous invading weed is Imperata. Imperata grassland is of common occurrence in most of these countries with an estimated total area of about 35 million ha, which is 4 % of the total land area (Garrity et al. 1997).

Imperata grasslands comprise other highly dynamic and spatially diverse invasive weed species. However, its role in the context of forest conversion has seldom been investigated on a regional scale over a period of several decades. In this presentation, as a specific example, we aim to delineate and analyze the temporal-spatial dynamics of land cover change of a previously forested area at the eastern margin of Lore Lindu National Park in Central Sulawesi, Indonesia. The synoptic, consistent and repetitive perspective of space borne satellite platforms allows a comprehensive and time-efficient monitoring of land cover dynamics over different temporal and spatial scales. Likewise, the availability of a time-series of historical and recent satellite imagery allows us to track land cover transition over three decades. Specific emphasis was put on mapping land cover changes as trajectories of physical surface variables (e.g. fractional vegetation cover) on a sub-pixel scale using linear mixture modeling.

We specifically investigate the progression of Imperata grasslands and the threat of Imperata invasion for the research area. Based on the interpretation of historical vegetation change, the potential spatial impact of weed invasion in the forest land is discussed and different future scenarios are outlined. Furthermore, results of an ongoing study that evaluates different management options to combat the invasive Imperata weeds that threaten to take over forested and

cultivated land are presented. The study envisions that if Imperata invasion can be prevented and controlled in presently cultivated land by the introduction of sustainable land use options for current and potential grasslands, the pressure of extending cultivations further into the forest frontiers may be reduced.

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Building Adaptive Co-Management: Lessons Learned from Participatory Modeling at the Forest Margins

This contribution is rooted in a number of considerations: the first being the limits of the expert-based approaches of natural resource management, the second is related to the emergence of paradigms like action-research and learning for transformation as well as participatory management, sustainable management and co-management. For the last one, the experiments and lessons drawn from the field came mainly from fishery or water resource management and more recently from the forest resource; very little of them has documented the processes conducted at the forest agriculture interface. However, this remains a crucial question in regards to the stakes that it poses for agricultural and forest sustainability in the humid tropics. The data come from the combination of: (1) a baseline conducted within the frame of Alternatives to Slash and Burn (ASB) Programme in Southern Cameroon; (2) the test of participatory modeling; (3) the participatory evaluation of the third phase of ASB (2000-2003).

The paper characterizes the strengths, weakness, opportunities and threats offered by the platform-based for social and institutional learning. In addition, the paper shows how the process increases the understanding of the stakeholders'configuration from as a agency-based approach to user-group approach. Moreover, the paper shows the practical uses of local indicators of change at the present with a projection on the future on which are based the development of participatory model. The analysis and discussions of the context and indicators brings about the liberation of a share vision of the future after negotiations between stakeholders. It's also appears that it is difficult to address the issue of agriculture sustainability based on only one resource but it should be rooted in many resource and land uses. The paper shows how participatory modeling can be a powerful plate-form for the integration of knowledge and experiences for the enhancement of adaptive NRM strategies at the forest agriculture interface with more feasibility perspectives.

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An Integrated Modelling Framework for Regional Land Use Change Analysis

Modelling of land use changes provides insights into their extent, location and effects. Consequently, land use change models can be considered important tools for integrated environmental management. Through scenario analysis one can utilize such systems for identifying critical locations of environmental changes in the near future. Since land use changes are a result of both biophysical and socio-economic driving forces, simulation systems need to be able to integrate different models reflecting these different disciplines. We present a technical solution of a system for integrated land use change modelling, called the SITE (Simulation of Terrestrial Environments) model, and its application to analyse land use changes in the STORMA project area. The main characteristics of this framework are its modular configuration by using a component-based design and the separation of necessary data structures from the actual application which enables it to work with multiple rule sets for a large number of applications. The main components are the user-defined rule set and the core simulation engine in combination with a graphical user interface. Beside these, the framework provides additional components that enable the integration of sub-models (demonstrated by the integration of the DAYCENT crop-growth model), the calibration of rule sets, the evaluation of simulation results and the management of simulation runs and simulation scenarios. The integrated modelling framework was developed and implemented as part of the STORMA project. For the presented application both data and models from different STORMA sub projects have been integrated.

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Silvopastoral Policies for Landscape Connectivity and Income Increase in the Tropical Dry Forest of Costa Rica

Protected areas in Costa Rica are relatively small, isolated and have low levels of connectivity, making them susceptible to loss of both genetic and species diversity. If biodiversity is to be conserved in the long-term, efforts need to be made to improve landscape connectivity in the surrounding agricultural landscapes.

Silvopastoral systems (i.e. the deliberate use of trees, cattle and pasture) provide opportunities to improve landscape connectivity in the form of biological corridors (such as live fences or windbreaks) or as 'stepping-stones' (such as dispersed trees in pastures). Silvopastoral systems can also improve farmer income earnings by providing products and services. However, there is a lack of applied analysis regarding silvopastoral policies in Central America and little knowledge about the tradeoffs between the design and use of silvopastoral systems for conservation versus production goals. The general objective of this research was to analyze economic incentives that can increase the use of tree resources (i.e. silvopastoral systems) by farmers in farms outside protected areas in the tropical dry forest of Costa Rica in order to improve landscape connectivity and rural incomes.

The analysis of economic incentives of a silvopastoral system (i.e. dispersed trees in pasture) was addressed by asking: 'what is the optimal combination of cattle and dispersed trees?' In essence, the question centers on estimating the direct net benefits (and their steady states) of cattle and timber in a dynamic setting. The effects of different policies on silvopastoral systems were explored through a sensitivity analysis in which projected input and output prices were changed. The social and economic complexities were simplified by grouping farmers into three farm types to obtain 'recommendation domains'.

The policy simulation was based on a discrete time (30 years) bioeconomic model that maximized net present values of cattle earnings and tree harvests for three different farming systems. The model considered the dynamics of both cattle and tree growth, and the interactions between them were modeled using canopy–pasture equations. Landscape connectivity was analyzed by simulating total tree canopy over time. The model used a nonlinear diameter growth model to simulate

timber growth. Three farmer types (according to a typology) were modeled. The effects of five policies that could affect the use of silvopastoral systems were simulated, namely: 1) lower hay costs, 2) improvements in calving rates, 3) lower meat prices, 4) higher timber prices, and 5) payments for environmental services in silvopastoral systems.

Preliminary results are discussed for each policy instrument and farm type separately. Regarding the policies that increase farm incomes, lower hay cost may have marginal positive effects for small-scale farmers. Prices would need to decrease by more than 60% for the farmers to start using hay during the dry season. For medium and large-scale farmers, lower hay costs slightly improve incomes. Lower local meat prices (a possible scenario under the Central America–USA Free Trade Agreement) can negatively impact small farmers. If prices are reduced more than 25%, the optimal livestock path for small producers is depletion of stocks. Medium and large-scale farmers, on the other hand, may still be in business with 25% lower meat prices. An improvement in calving rates, which can be achieved with better cattle management with current technologies, may greatly increase incomes of small-scale farmers. Given the current levels of tree densities, higher timber prices may slightly increase incomes per hectare of the three farm types.

The model showed that current structure of the tree component (i.e. the diameter distribution pattern) is not sustainable, as there is little active regeneration in pasture. The model simulated the transition path from the current stand structure to a sustainable one and showed that both the transition path and the steady state are financially profitable. Therefore, policy interventions should be focused on promoting a better distribution of tree sizes (and enhancing natural regeneration in pastures) instead of financing tree planting or paying for existing trees. Therefore, policy instruments such as technological assistance to promote sustainable management of trees may have a better impact than a direct payment to ranchers.

The implications of the research are twofold. Firstly, silvopastoral systems are suitable production options for small-scale producers. For instance, high discount rates prevent farmers from having pure forests, but high incomes can be achieved with the integration of trees into existing pastures. Second, policy instruments focused on cattle management (such as improvement in calving rates) and tree management (improvements in stand structures) are preferred instruments for maintaining tree cover and improving incomes in pastoral landscapes.

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The Activities of AFRD: Biodiversity of the Georgian Orchids

(Extracts from Poster)

(…) Georgia is divided into so called "vertical zones". There are different physical, geographic and climatic conditions on this relatively small territory. We can come across almost all kinds of soil and climate existing in the world. With a long growing season and some areas of subtropical climate, citrus and a variety of deciduous fruits, vegetables and vine crops grow well along with tea, cereals, sunflower and a variety of field crops. Much of the milk from cattle and sheep is used to make cheese. With the variety of climates, almost any crop can be raised, giving Georgia one of the most diverse agricultural bases in the former Soviet Union. Due to its strategic geographical position between Europe and Central Asia, Georgia remains the gateway for land transportation across the Caucasus, using its ports as bridges; its location on the Black Sea is one of the country's foremost natural assets. Some overland routes are problematic, but Georgia is publicly committed to building a functional trans-Georgia transportation infrastructure to its Caucasus and Central Asian neighbors.

Farming in mountainous areas is mostly developed in Georgia; farming in plain areas is well developed as well. In order to get good yields of agricultural crops there is a necessity to conduct activities connected with irrigation (Eastern Georgia), draining (western Georgia) and soil protection (against erosion). Many farmers in developing countries recognize the need to use safe and sustainable farming methods, but much of the information and advice available to them, influenced by chemical companies, promotes high levels of external inputs. The inputs recommended are not only environmentally unsound but are often too costly for small-scale farmers. (…) Georgia is biologically very diverse. It may very well have been the first place where grapes and wheat were domesticated. A great number of native varieties of plants and animals are observed here representing the best selection material due to their particular genetic features. At the same time, climate makes Georgian agriculture is risky. This situation may further worsen as a result of global warming. To ensure harvest of agricultural crops, along with irrigation (East Georgia) it is necessary to undertake drainage (West Georgia) and soil protection (against erosion, salivation etc.) measures. (…)

ORCHIDS IN GEORGIA

Family Orchidaceae is one of the largest diverse plant families. There are up to 725 orchid genera and about 20 000-25 000 species. Among them, 25 % of all orchid species are terrestrials (grow in the soil), 70 % are epiphytic (grow on

trees), the 5 % grow on different subtracts. Some orchids, such as Rhizanthella gardener, spend their entire life underground, even flowering proceeds in the soil and only apices of inflorescence bracts show aboveground. (…)The Orchidacae is a cosmopolitan family found almost in all climatic zones. They occur very near the limit of vegetation from arctic to the most extreme desert environments. Epiphytes are limited to tropical and subtropical environments, while terrestrial orchids occur in all climatic zones. In temperate zone, where Georgia is located species are terrestrial. Mostly, these are geophytes with ephemeroidal life cycle. After flowering, the aboveground parts of the plant die off and only subterranean rhizomes and tubers continue living activity. Most Georgian orchids are autotrophic, however four species-Corallorhiza trifida, Epipogium aphyllum, Limodorum abortivum and Neottia nidus –avis are arhorophyllous saprophytic plants. (…)At present, existence of 20 genera and 51 species is confirmed for Georgia. Among them, two species are represented by two subspecies each. (…)

CONCLUSION

Successfully conservation of threatened species calls for the protection and management of their habitats. However, in reality it is extremely difficult to realize this, because the preservation of actual habitats is generally an economic problem and is more or less limited. The existing protected territories not always coincide with local areas of distribution of rare and endangered species. Therefore, more knowledge is needed regarding the spread of Georgian orchids to determine better the localities to be protected in the future. The latest studies of Georgian orchids have shown that the exploration of wild orchids species that might be more new data to be obtained in the future. (…) In general, the conservation of Georgian wild orchids is viewed as unsatisfactory. We hope that in the problems will be resolved and the survival of the whole diversity of orchids will no longer be threatened.

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Comparisons of CO2 and H2O Budgets of Several Agro-Forestry Ecosystems in Indonesia: Results of Modelling Experiments

Deforestation of tropical rainforest areas due to both natural (e.g. climate change, windthrow) and anthropogenic (e.g. air pollution, timber production, slash and burn agriculture) factors results in changes of energy, water and CO2 budgets of land surface, and as consequence, in changes of local and regional environmental conditions. The changes depend on climate, relief, vegetations and soils, as well as on many other factors. Some studies show that deforestation is associated with a decrease in transpiration, an increase in runoff and an increase in loss of particulate material and dissolved nutrients (Binns 1986). Other studies argue that forests have not any significant impacts on surface runoff (Calder 1999). It can be expected that deforestation leads to increased solar radiation at the ground surface, which may cause an increase of surface temperature. These changes may have significant impacts on both terrestrial and aquatic species. From the other side, decreased surface roughness and increased wind speed can have an opposite effect on surface temperature.

To quantify the possible changes caused by forest canopy removal, universal techniques allowing consideration of the influence of various factors and processes determining the heat, water and carbon balances of a land surface are required. Mathematical models of different levels of complexity are one of the most promising and powerful tools for prediction of such changes.

Within the framework of this study, different components of energy, water and carbon balances of various land-use types (e.g. tropical rainforest, grassland and agricultural crops on clear cutting areas, plantation of cacao) in Central Sulawesi, Indonesia, were quantified and compared using a dynamical process-based SVAT model "MixFor-SVAT" (Oltchev et al. 1996, 2002). Tropical rainforests are generally characterised by a wide variety of tree species and by significant vertical and horizontal heterogeneity. These features require a sufficiently detailed description of the vegetation properties and the processes occurring within a forest stand. However, at the same time, the model complexity should be well adapted to the objectives of model experiments and with available input data.

Mixfor-SVAT model allows to estimate not only the total energy, water and CO2 fluxes (that can be obtained using and more simplified model approaches), but also to quantify the contributions of the different tree species and different canopy layers and soil to total fluxes, to describe a microclimate inside a vegetation canopy, and to predict plant and soil water dynamics.

Simulation of the energy, water and CO2 exchange in Mixfor-SVAT is based on integrated description of the physical and biological processes on the leaf, tree (plant) and stand levels that allow to apply this model to different vegetation types from grassland to mixed forest stand represented by one or by many different tree species.

It is assumed that in a mixed forest stand the different trees of different tree species are uniformly distributed over some homogeneous ground surface area, and there are no differences in structural and physiological properties between the same tree species. Each tree species in a forest can be characterised in the model by individual sets of morphological (e.g. height, LAD, stem diameter, root depth), physical (e.g. optical properties of the leaves and bark, hydraulic conductance and storage capacity) and physiological (e.g. maximal stomatal conductance, maximal Rubisco carboxylation capacity, maximal rate of photosynthetic electron transport) parameters.

Grassland vegetation is characterised in Mixfor-SVAT by one set of morphological, physical and physiological parameters estimated by averaging of individual plant properties.

The meteorological input parameters used in the model are the air temperature and humidity, wind speed, CO2 concentration, precipitation and global radiation at some reference height above a vegetation canopy.

Model was validated using results of eddy covariance measurements of the energy, H2O and CO2 fluxes in natural forest stand in Bariri and in cacao plantation in Nopu in 2002-04.

This study was carried out within the frameworks of the German-Indonesian project "The stability of rainforest margins in Indonesia" (STORMA, SFB 552) supported by DFG.

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Effects of Land Use and Land Use Change on Carbon Dioxide Uptake and Release in the Tropical Rain Forest Margin Area in Indonesia: A Regional Modelling Study

Effect of land-use changes on carbon dioxide uptake and release due to deforestation of tropical rain forest was investigated in the Lore Lindu National Park (LLNP) in Central Sulawesi (Indonesia) using process-based regional SVAT model SVAT-Regio (Oltchev 2003).

The LLNP is an unique area which contains one of the largest intact forests in Indonesia. Its deforestation due to mainly economic activity of a very rapidly growing population in and around the park can result in serious threats for forest ecosystems and in loss of various flora and fauna species. It can be expected, moreover, that deforestation of this are can result in decrease of CO2 uptake and increase CO2 release into the atmosphere. Climatic anomalies such the El Nino Southern Oscillation (ENSO) phenomenon resulting in a strong decrease of precipitation in this area can also influence the CO2 ecosystem balance.

Two principal land-use scenarios were generated to study effect of land use changes on carbon dioxide uptake and release. Both scenarios assume a decrease of areas covered by intact tropical rainforests and an increase of agricultural and grassland areas. The first scenario assumes a decrease of forest areas by 10%, and the second scenarios - a decrease of forest areas by 20% from the present conditions. Distance from inhabited areas was taken as the main factor for prediction of deforestation rates in the different parts of the LLNP.

The carbon dioxide uptake and release in regional scale were modelled for entire area of the LLNP for period from January to December 2003. Grid cell resolution of the model was 500 m × 500 m. Time step - 1 hour. Spatial distribution of the different land-use types at present was described from analysis of LANDSAT ETM+ data (Haertel et al. 2002). Spatial pattern of leaf area index (LAI) was derived from analysis of NDVI data (LANDSAT ETM+) and field measurements at target experimental plots. Regional pattern of meteorological parameters was reconstructed using the own measurements at 10 mobile meteorological stations. Ecophysiological parameters for different vegetation types were determined from

own measurements and also collected from scientific publications in literature.

Modelling procedure included several consecutive steps:

1. Spatial interpolation of the meteorological data from nearest meteorological stations to individual grid cells to which the entire study area is divided.

2. Simulation of energy, water and carbon fluxes within and above vegetation canopy, canopy microclimate, canopy and soil hydrology for each grid cell using meteorological data and biophysical properties of vegetation and soil.

3. Integration of energy, water and carbon fluxes over the area (e.g. catchments, entire study area) and over the time (e.g. day, month, season, year).

Interpolation algorithm takes into account relief and land-use structures of the study area. The model assumes that the land surface, soil and vegetation within each grid cell are spatially uniform, but vegetation, at the same time, can be represented by different species.

This study was carried out within the frameworks of the bilateral German-Indonesian project "The stability of rainforest margins in Indonesia" (SFB 552) supported by the DFG.

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Integrated Conservation Strategy for Industrial Plantation Landscapes - Taking a Landscape Approach to Ensure that Costs and Benefits of Social and Environmental Services are Internalized

This paper will describe an Integrated Conservation Strategy (ICS), a framework and a process for integrated conservation of biodiversity and other natural resources. It takes into careful consideration socioeconomic, ecological and technical/management issues, and is based on/backed by research. The focus is on large-scale industrial plantation landscapes, and describes a holistic approach to ensure that the real costs and benefits of socioeconomic and ecological services of the landscapes are taken into account, at least in a qualitative manner.

Conservation in large managed/plantation landscapes is most effectively achieved through appropriate management and design of natural forest corridors and other natural areas set aside from production, paying attention to both a) the connectivity of such areas at the landscape scale, and, b) the broader landscape context. The latter is particularly important, as many plantation concessions are not contiguous and are scattered over a very large area.

The ICS is an approach to mainstream conservation into the management of plantation companies and the organization as a whole, in part through improved understanding of the economic implications/incentives associated with conservation measures – long versus short term economic issues will be emphasized.

It applies participatory system dynamic models as a tool to discuss and reach common/mutual understanding, among departments across management levels, and with stakeholders, the benefits and costs provided by various elements of the wider landscape in which the plantations are located.

A participatory monitoring and assessment program/system of the performance of the conservation measures is described.

The approach taken assumes and implies that maximization of production will be sought at the level of the overall concession rather than at the level of more or less autonomously managed sectors of the concession. This allows optimization of production goals, and takes into account potential trades/offs between sectors regarding production and conservation.

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Future Deforestation will Affect Pollination Services and Economic Returns in Coffee Agroforestry Systems

The ecological and economic consequences of rain forest conversion and fragmentation for biodiversity, ecosystem functioning and ecosystem services like protection of soils, water retention, pollination, or biocontrol are little known. In human-dominated, mosaic-like tropical landscapes, forest remnants may act as source for beneficial organisms immigrating into adjacent agricultural or agroforestry plots. In this study, we use empirical data on the negative effects of increasing forest distance on both pollinator diversity and fruit set of coffee to estimate future changes of pollination services in different land-use scenarios. The spatially explicit land-use simulations demonstrate that even moderate land cover changes have a significant impact on the yields of arabica coffee, which may be reduced up to 18 percent due to the up to 44 percent reduction in nearby forest areas within the next two decades (compared to average yields of the year 2001). Depending on the magnitude and location of ongoing forest conversion, pollination services are expected to decline continuously and thus directly reduce the net revenues per hectare between 0.3 and 14 percent. Present forests in the study area annually provide pollination services worth 46 Euros per hectare. Our simulations indicate that much of the ecological and economic value can be preserved, if patches of forests are maintained in the agricultural landscape, which could be a viable option for local farmers and regional land use planners.

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Deforestation – a Household Perspective

In the vicinity of the Lore Lindu National Park (LLNP) forests disappeared at an alarming rate of 0.6% per year between 1972 and 2001. During the same time the agricultural area ex-panded drastically, especially since the introduction of cocoa in 1979. As nearly all the agri-cultural land belongs to smallholders this paper focuses on the decision making process of households concerning the conversion of forest to agricultural land. By using household level data we are able to overcome limitations of higher aggregated models of land-use change which often fail to take into account important factors like for example poverty and access to credit.

The aim of this paper is to reveal the underlying factors which drives rural households to clear natural forest for the cultivation of crops. Specifically, the following research questions will be addressed: (1) How much natural forest was cleared? (2) Are there any differences be-tween socio-economic groups? (3) What determines the decision to clear the natural forest? Household and plot level data was collected through standardised, formal questionnaires from 267 households. The same households have been interviewed in 2001 and 2004.

Since 1996, 31% of all households have cleared on average 1.0 ha of natural forest for the cultivation of crops, especially cocoa. Applying an index of relative poverty we differentiate three different wealth groups: poorest, poor, and better-off households. The share of house-holds, which have cleared natural forest, is significantly lower between the poorest/poor households (35% and 39%) and the better-off households (18%). However, the average area cleared does not differ between the socio-economic groups.

Econometric modelling techniques will be used to identify external, household and plot char-acteristics which influence the households' decision to clear natural forest for the cultivation of crops. Policy conclusions will be drawn and the results will be compared to the findings of already existing spatial models of land-use change.

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Linking Household Data and Geodata – an Interdisciplinary Approach Applied at a Tropical Forest Margin in Indonesia

An understanding of the dynamic connections between human behavior and the natural environment requires that people and land be spatially linked. This poster describes the design and execution of a concept relating households and land parcels in the village of Toro, Central Sulawesi. The main objective of the study is to reflect the interactions between household dynamics and land use decisions at the rain forest margin area. Via the integrated methodological approach the working group will derive conclusions on the spatial distribution of socio-economic factors concerning the land use stability in the surroundings of the Lore Lindu National Park.

Within the framework of the interdisciplinary research project "STORMA" (Stability of Rainforest Margins in Indonesia, SFB 552) a comprehensive data base on socio-economic as well as on geo-data is given. On one hand a socio-economic household survey was conducted in 2004 for every household in the village and on the other hand GPS data on land parcels were measured along a transect which reflects the land use gradient of the research village. In a first step the household data have been analysed statistically, after that the results have been validated and then linked to spatial attributes on a per field basis. This spatial linkage provides the opportunity to connect the household data to spatially explicit data (e.g. high resolution remote sensing data, land cover and land use, etc.) that are stored and analyzed in a GIS. Along the landscape transect a visualization of the linkage between household types (defined by socio-economic indicators such as poverty, ethnicity or knowledge) and changing land use intensities (e.g. paddy, agro-forestry) will be enabled. These prospective interrelationships may help to better understand effects of household decisions on land use and land cover change at the rainforest margin over time.

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Surface and Sub-Surface Run-off Characteristics from Forest and Agro-Forestry

Conventionally, forest has been always viewed as the most superior land use in improving hydrologic watershed function. In this respect, a forest is perceived as being a collection of trees. This is evident in reforestation projects, whose efforts are focused on tree planting as a means of 'regenerating' degraded and/or deforested forests. By analyzing this conventional view critically, we will be able to bring about an understanding of the truth, which relates to the effects of land use change on watershed functions. The hydrological functions of forests appear to have been erroneously attributed to the trees rather than to the properties of soils in forested landscapes.

The objective of the research was to compare soil profile hydraulic conductivity below forest and agro-forestry land use by measuring proportion of surface and sub-surface run-off from both land use. Hydraulic conductivity parameter of soil profile is responsible in regulating role of forest and other land use in hydrologic watershed function. For this purpose, surface run-off volume from upper layer (0-40 cm) and sub-surface run-off from lower layer (40-60 cm) in both land use were measured. Higher hydraulic conductivity will cause lower run-off volume.

Surface run-off from upper soil layer in forest land use is higher from that of agro-forestry land use, but on deeper soil layer (>40 cm) run-off volume from forest and agro-forestry did not differ significantly. The reason was that soil hydraulic conductivity from both land use in deeper layer was not significantly different. This difference is even less significant for longer rainfall duration. Therefore, for longer rainfall duration role of forest compare to other land use such as agro-forestry in reducing flooding might be overstated.

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Estimation of Leaf Area Index under Dense Canopy Conditions Using Hemispherical Photography and Multi-Scale Optical Earth Observation Data: Prediction Capabilities of Spectral Indices and Artificial Neural Networks

Leaf area index (LAI) is a key environmental variable that constitutes a key input to various ecosystem productivity models as well as global models in hydrology, climatology and biogeochemistry. The application of such models is largely influenced by the availability and quality of the input data. It is crucial to obtain the spatial distribution of leaf area index in order to accurately determine ecosystem productivity and health. Spaceborne earth observation data is the principal means to estimate and map biophysical variables at a variety of different scales, both spatially and temporally. It is the only method of obtaining continuous spatial information on important biophysical variables such as canopy gap fraction and leaf area index.

Empirical LAI models based on spectral measurements from spaceborne platforms require an adequate number of in-situ observations. Since direct measurements of leaf area index through destructive harvest or litterfall are impractical and undesirable in natural tropical forests, indirect methods for estimating LAI are required. Gap fraction analysis based on hemispherical photography is an indirect method of estimating LAI (Norman and Campbell 1989) that has gained in importance over the last years. Recent advances in instrumentation and the improvement of gap fraction inversion models, from which biophysical characteristics such as leaf area index and mean leaf inclination angle can be inferred, have increased the attractiveness of this technique (Jonckheere et al. 2004, Weiss et al. 2004).

This study evaluated linear and non-linear predictive models between atmospherically and topographically corrected spaceborne earth observation data and in-situ measurements of forest stand variables. Gap fraction and leaf area index were calculated from digital hemispherical photographs which were collected from over 100 GPS-registered plots. Each plot consisted of 10 single measurements that were averaged and related to the according pixel reflectance. The plots were stratified to span the variety of different land cover types within the research area in Central Sulawesi, Indonesia.

Regression analysis included single and multiple spectral bands and band

transformations.

As an additional inversion technique, artificial neural networks (ANNs) using non-linear transfer functions have been explored to infer leaf area index from remotely sensed satellite data. In order to estimate the prediction and generalization power of the inversion, standard cross-validation techniques and sensitivity analysis were applied.

Due to canopy-shading and saturation effects, the predictive capability of the commonly used NDVI is limited at LAI > 4-5. Results show that biophysical variables of tropical forests are best predicted using a combination of visible and middle-infrared wavelengths.

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Cultural Driving Forces of Land Use Decisions - Evidence from Rainforest Margins in Central Sulawesi, Indonesia

Located within the region of Wallacea, the island of Sulawesi represents one of the world's most important hotspots of biodiversity. The Lore Lindu National Park plays a crucial role in the conservation of endemic fauna and flora, as it is one of only two larger protected forest areas in the province of Central Sulawesi. Like in other regions, however, this site is endangered by the impacts of human action. Besides encroachments of the protected forest areas, different land use patterns and practices may decrease or increase the degree of biodiversity at the rainforest margins. Besides external factors (policies, environmental conditions, etc.) the individual or group specific decisions of human actors play a crucial role for answering the question: Why do certain people at a certain place plant a certain crop in a certain way? While often economic reasons are investigated in this context this study aims to reveal the importance of cultural driving forces that influence people's decisions on the management of common pool resources.

For this research, as part of the DFG funded collaborative research program SFB 552 – STORMA "Stability of Rainforest Margins in Indonesia", we conducted a quantitative census comprising every household of three villages in the vicinity of Lore Lindu National Park, Central Sulawesi. The villages (sites) were selected in respect to their dynamics of change. We assumed that site A represents a village the inhabitants of which put much effort in the preservation of forest resources while site C is characterized by a high degree of migration related land use changes with comparatively more instable man-environment interactions. The third site (B) may be regarded as a village in transition and being ranked between village A and C along a gradient of dynamics of change.

We first isolated groups of households in each village according to the most common land use patterns. These land use pattern groups are defined by variables such as type of plot along a land use gradient, crop composition, field size, distance to the field, soil quality, slope, and yield. In a second step, we tested different cultural factors (e.g. ethnicity, migration, education, and knowledge) for their impact as causal factors that influence the affiliation of households to the one or the other land use group.

Some first general results affirm the assumption of the ranking of the three study villages along a gradient of dynamics of change. While 70% of the inhabitants of village A belong to the respective local ethnic group, this share is only 50% in village B and 25% in village C. More than 50% of the fields in village A are cultivated with paddy, followed by agroforestry under naturally grown shade trees and planted shade trees. The amount of agroforestry plots with planted shade trees increases along the gradient of dynamics of change to more than 60% in village B and to more than 80% in village C. The highest degree of dry land rice cultivation can be found in village B. 55% of all households in village A cultivate cacao as main crop while the second most important main crop is paddy (36%). The most frequent additionally planted crops are coffee (41%), vanilla (27%), maize (11%), and fruits (8%). In village B cacao represents the most important crop with a share of 88% of all households planting it as their main crop, followed by maize (8%). As additional crops, maize (40%) and fruits (39%) are grown while vanilla (9%) and coffee (5%) play an inferior role in this village. The village with the assumed highest dynamic character (C) is almost totally dominated by cacao as main crop (96%). Here, maize (41%) and vanilla (36%) are the most frequently planted additional crops.

The analysis of the correlations between land use groups and cultural factors of influence that will be presented in this paper will allow to identify the cultural driving forces of human actors' land use decisions. The discussion of the results will support recommendations for local, regional and national policies of balance between the interests of nature conservation on the one hand and the welfare of the local population on the other hand.

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Gender Aspects in Tropical Agriculture: A Qualitative-Empirical Case-Study in Central Sulawesi, Indonesia

The protection of the topical rainforests is a global challenge that is not called into question but in many cases it contradicts with the (agrarian) necessities of the local people in tropical regions. To find and to adopt ecological as well as economical sustainable land use systems is, therefore, one of the primary goals for the future. As pointed out in focus 1 of the symposium the understanding of the dynamics of land use change and the influence of the different actors on common and privately owned resources form crucial aspects to achieve this aim. Recently many studies have investigated the impacts of and the influences on the households in this context. However, in these studies the households are seen mostly as one common actor without considering that within the diverse members of a household there may be a lot of different interests and bargaining positions.

The research was carried out within the framework of the SFB 522 Stability of Rainforest Margins (STORMA) in two villages in the vicinity of the Lore Lindu National Park in Central Sulawesi, Indonesia. The aim of the study is to analyse the different impacts that men and women have on the agroforestal land use. Therefore this research tries to identify the gender specific differences in the economic, social and cultural life of the villagers and to investigate its implications on land use decision-making processes. We conducted qualitative semi-structured interviews with male and female members of various households as well as with male and female key-persons on village level. Also we used some participative PRA (Participatory Rural Appraisal) methods such as participatory mapping, participatory observations and group discussions. Thereby we focused the point of view of the informants themselves about typical tasks in the households, village and on the fields, participation possibilities and social positions of both gender.

Although the frame conditions considering the land use and the history of the two villages differ a lot, some general results can be formulated. Relating to the grade of participation in cultivation processes there seems to be a change of women's role in the course of the implementation of cacao cultivation. Whereas men and women play similar roles in the traditional rice cultivation – a crop that is mainly used for the own consumption – most women are less involved in and have less knowledge about the recently established cacao cultivation – mainly used as cash crop. However, women are regarded as treasures in the families which put them in a strong bargaining position. In spite of the fact that women's participation in

political sphere is less than men's the main concept of the social life is the one of "discuss and consensus" focusing that for all decisions there must be an agreement of all members of a social group. In practice this means that the opinions of both gender will be respected in the households as well as within the respective village – if they have the individual ability to express their ideas.

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FOCUS 2:

Sustainable management of agroforestry systems

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Conservation Attitudes and Customary Custodianship: The Impact of 'Village Conservation Institutes' upon Ethnic Groups of the Lindu Enclave in the Lore Lindu National Park (Central Sulawesi, Indonesia)

One of the major problems that has plagued the re-activation of customary rights to land and other resources as part of the regional autonomy initiatives of post-New Order (i.e. Reformasi) Indonesia is the failure to consider the multi-ethnic composition of most all rural villages in contemporary Indonesia. Migrant groups have often felt disadvantaged and indeed disenfranchised by the resurgent claims to these resources made by representatives of those local groups claiming indigeneity as the warrant for their resource claims. The crucial question thus becomes just whose custom (adat) is to be recognized as the basis of claims to land and resources.

This paper examines an alternative form of organization that explicitly attempts to foster multi-ethnic participation at the local level in the project of regulating claims to local sylvan and agrarian resources. It treats the discursive transformations and practical techniques of surveillance effected by the formation of 'village conservation institutes' (lembaga konservasi desa or LKD) by The Nature Conservancy (TNC), a transnational environmental NGO working as co-administrator with the Indonesian government of the Lore Lindu National Park (TNLL). The formation and operation of these LKD are examined in the context of the Lindu enclave within this national park. The paper discusses the politics of how indigenous Lindu elders appointed to these bodies have attempted to control these organizations, using their newly revitalised status to represent indigenous Lindu custom (adat) as the conceptual precursor and contemporary sanction provider for park regulations.

The paper also treats how the LKD are nevertheless recasting alliances among communities in the Lindu plain, pitting formerly opposed longer-term residents, including Bugis and Kulawi migrants, against more recent migrants from Tana Toraja opening gardens beyond enclave boundaries. While acknowledging the cooptation of LKD representatives to the TNC agenda of biodiversity conservation, the paper also shows how actors from various constituencies in the plain use environmentalist discourse and conservationist discipline for their own purposes. It also includes consideration of changes in attitudes toward the environment in assessing the impact of the LKD in working for conservation goals among the various ethnic groups involved in and excluded from LKD membership, based on a survey of conservation attitudes among samples from various groups resident in the Lindu enclave, undertaken in 2005. It thus asserts

the importance of considering local agency as well as external appropriation in the local-level politics of land and resource claims and the contestations surrounding conservation initiatives, especially as these have been opened up by the decentralization initiatives of Reformasi in Indonesia.

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The Role of Biological Nitrogen Fixation in the Cacao Agroforestry System in Central Sulawesi Indonesia: Implication for Management Practices

Research was conducted at two sites (Kaduwaa and Makmur) in 7-8 years old cacao agroforestry system in Central Sulawesi Indonesia to evaluate whether Gliricidia sepium (Jacq.) Walp. plays a major role in the restoration of soil fertility in the system and what are the implications for management practices. We quantified the proportion of nitrogen derived from atmosphere (%Ndfa) with the 15N natural abundance method (15NNAM) and the 15N enrichment method (15NEM) and determined the aboveground biomass of Gliricidia by destructive and non-destructive methods.

The estimate of %Ndfa of Gliricidia ranged from 31 to 34% determined with the 15NNAM and from 53 to 57 % with the 15NEM using cacao and coffee as non-fixing reference plants. On average, the rate of N accumulation in the biomass of Gliricidia was around 40 and 43 kg N ha-1 yr-1 in Kaduwaa and Makmur, respectively, resulting in total N-input of 321 kg ha-1 in Kaduwaa and 369 kg ha-1 in Makmur in 7-8 years. Of those annual amounts, the BNF in the system contributed around 13-22 kg N ha-1 yr-1 as the stock in the Gliricidia trees. Of the 82-87 kg N ha-1 yr-1 input from pruning and litterfall into the system, biological nitrogen fixation contributed 28-47 kg N ha-1 yr-1. Thus, Gliricidia plays a major role in maintaining the N balance in the cacao agroforestry system. The N balance in the system ranged from -15 to +17 kg ha-1 yr-1 depending on the respective quantities used for calculation. If the system was to be converted to a cacao monoculture, which is a practice performed by some farmers in the region, to maintain the soil fertility at the current level, farmers would have to invest 36-38 Euro; for Nitrogen-fertilizer per hectare and year. Therefore, improving management practices in traditional cacao agroforestry system is a better option than converting to cacao 'monoculture' plantation system.

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Institutional existence and performance around Lore Lindu National Reserve

The existence of rural institution for two decades has been working as a part of community development to empower rural poors surrounding Lore Lindu National Reserve (LLNR). Its performance has led to be indicator for rural agricultural development since establishing the LLNR has protected area. Its Existence and performance should be taken into consideration of both government and whole community because it may relate to strenghening of rural community and enhacing of their welfare.

Therefore, the role and the function of rural organisation in the community and their participation of the community on rural organisation need to be assessed and to be analyzed in order to know its achievement of the obyective of organisation. This study is focusing on how the existence and the performance of rural organisation surrounding the national reserve, and how the rural communities participate and take role on the activity of the organisation, and what factors are influencing its performance and community participation?

The study conducted through collecting data and information in six rural surrounding the Lore Lindu National Reserve, then interviewing several stakeholders who related to rural organisation. There are three types of rural organisation; (1) NGO (CARE, CSIAD-CP), (2) Agricultural activity (Agricultural extension, Farmers group), (3) Micro Finance Services (Micro credit service unit, Rural investment credit, and Public service credit), then there are four categories based on its obyective; (1) Community empowerement organisation, (2) Economic organisation, (3) Agricultural organisation, and (4) Social organisation. While its performance varied through the obyective of the organisation, membership, activity, activity supporting the obyective, the structure of the organisation. The government, community and public servant also varied in their involvement in the organisation, as planner, implementer, employee and as contributor (capital).

There are 67.73 % active organisation, 17.85 % run as usual based on needs, and 14.28 % unfuntioned organisation. Rural organisation looks well established but unwell managed based on goal achievement. Its performance also looks up and down depending on support activity and its officers. Less than half of them concerned with sustainability of the forest mainly due to less understanding and focusing on basic need oriented activity. Nevertheless, the existence of rural organisation looks existed especially when outsider institution begin to come to help and to do for empowering rural community, while its performance looks less

performed in running to serve the community. It needs high attintion from both local government, NGO and the community it self to develop rural institution. There are still more spaces to drive them to pay more attention on sustainability of the LLNR through enpowering and strengthening rural institution.

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Quantity and Value of Native and Exotic Tree Species Present in the Coffee Based Agro Forestry Systems

Coffee is the major plantation crop in the Kodagu district (South India). This occupies 29 percent of the total geographical area of the district. Due to current fall in the coffee price in the last decade farmers are looking for timber as an alternative source of income to meet their economic requirements. Due to longer rotation and slow growing nature of the native tree species planter prefer fast growing, short rotation exotic tree species. The present paper is an attempt to evaluate the quantity and value of native and exotic tree species present in the coffee based agro forestry systems of Kodagu. It was found that the nearly 14.63 cu. m/ha of the timber worth 5.41 lakh/ha in large plantations and 12.66 cu. m/ha of timber worth 4.76 lakhs/ha in small plantations was contributed by native trees species. On the other hand, exotic trees in larger plantations have contributed 2.68 cu m/ha of timber worth 0.89 lakhs/ha 2.79 cu. m/ha worth 0.93 lakhs/ha by small plantations. That is, exotic trees contribute to17.31 and 18.69 percent of the total stumpage value in large and small coffee plantations respectively.

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Contribution of Agroforestry in Rural Livelihoods of People in Nepal

Nepalese farmers have been growing trees, fuelwood and fruit trees on the bunds of terrace fields, marginal land and along the streams bank and raising animals Traditionally. During the mid 70s different models of agroforestry were developed and disseminated to reduce the pressure on the natural forest. However, agroforestry is still regarded as a means to reduce the dependency of people on natural forests and its resultants socio-economic benefits are often largely ignored. Recently a study was undertaken in three western Terai districts of Nepal to find the incidence agroforestry practice and its contributions to the livelihoods of the people. For the purpose of this study, 150 farmers were interviewed in-depth and how they had been managing their farms were studied through participatory study methods.

This study showed that majority of the farmers are still unaware of many benefits of agro-forestry and majority of them have practiced agro-forestry simply to meet their demand of forestry product and for free access to the seedlings. The study reveals the absence of scientific management of agroforestry and farmers give priority to crop management as compared to the tree management. Farmers have complains for both the quality and quantity of the services available through the government sector. Cash flow analysis of agroforestry models reflects that agroforestry models have high return compared with agriculture crops and hence can be promoted as one of the most viable options for improving the livelihoods.

This study has identified some of the crucial issues, which need to be addressed for practicing agroforestry as a vehicle to improve the people's livelihoods as well as for the scientific management and expansion of the agroforestry system in the country. The study suggests to follow need based approach and not induced, promote agroforestry and provide management assistance, develop capacity and not to provide incentives, and follow adaptive approach rather than adoptive. The focus of agroforestry should be to increase number of trees in the landscapes rather than changing the land use pattern. The study also suggests to follow market oriented approach rather than subsistence and makes coordinated efforts and not unilateral one.

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Responses of Lower Canopy Beetle Communities to the Conversion of Rainforests to Agroforestry Systems in Indonesia

Due to the ongoing loss of tropical rainforests, the potential role of agroforestry systems for the conservation of tropical arthropod diversity becomes an important but little known issue. We compared beetle-communities in and adjacent to the Lore Lindu National Park, Central Sulawesi, Indonesia, from forest sites (n= 4) with those from three types of cacao-dominated agroforestry systems (n= 12) representing an increase in land-use intensity: shaded by remnants of natural forest, shaded by a diversity of planted trees and shaded by one or two species of non-native leguminose trees. We collected the beetles by canopy foggings from cacao trees in the agroforests and from similar-sized understory trees at the natural forest sites. The beetles were sorted to species by experts. Surprisingly, highest beetle diversity (e.g., Fisher's α) occurred in the agroforests shaded by forest remnants, while community structure differed between forest sites, agroforests shaded by forest remnants and the two other agroforestry systems with planted shade trees. Only few beetle species found at the natural forest sites was also found at the agroforestry systems, but agroforestry systems under natural shade supported the most. In addition to diversity, percent predators was highest in agroforests shaded by forest remnants indicating high potential for biological control. Diverse stands of planted shade trees did not support higher beetle diversity than monospecific stands. In contrast to expectations, spatial turnover within land-use types (β-diversity among sites) was in agroforestry systems as high as in the forests. The high turnover between management types explained over half of the overall diversity, which emphasizes the importance of a landscape perspective in biodiversity management. In conclusion, the poorly studied canopy fauna in cacao-dominated agroforestry systems showed an unexpectedly high beetle diversity and was influenced by management type in that conserving natural forest trees for cacao shade greatly enhanced diversity.

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Socio-economic Drivers of Biodiversity in Indonesian Agroforestry Systems

Conversion of tropical rainforests to land-use systems caused unprecedented effects on tropical biodiversity. However, the choice of management type matters greatly in the conservation of biodiversity. We hypothesise that cultural and socio-economic factors play an important role in the decision making of farmers in relation to land use and through that have impact on the conservation potential of their land for biodiversity. Our study addresses the following questions: (1) How do different agroforestry systems differ in terms of biodiversity? (2) Which cultural and socio-economic driving forces can be observed in relation to the biodiversity of the distinct agroforests? (3) Which causal links play a role in this interrelation?

In a multidisciplinary approach we studied cultural and socio-economic aspects of farmers in the village of Toro, Central Sulawesi, Indonesia and the biodiversity supported at their differently managed cacao dominated agroforestry systems. For achieving the cultural and socio-economic driving forces on land use decisions of the farmers we used a standardized census questionnaire covering topics such as ethnicity, status of prosperity, access to and quality of land. With fogging samples from the cacao canopy the diversity on these farmers land was studied, focusing on beetles as an extremely species-rich group of organisms. The fieldwork for this interdisciplinary cooperation has been carried out within the framework of the DFG funded collaborative research program SFB 552 – STORMA.

The data of the diversity investigation reveal that agroforestry systems shaded by remnants of natural forest support highest beetle diversity while those shaded by planted trees lowest. The agroforests shaded by remnants of natural forests were owned by poorer people resulting in a highly significant and negative correlation between prosperity and beetle diversity. This may be due to more extensive management driven by poorer soils and longer distances to plantations. The results and discussion that we present proof the importance and value of combining socio-economy and ecology for a better understanding of socio-economic drives of biodiversity in forest margins, providing improved tools for nature conservation politics.

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The Influence of Pollination, Herbivory, Non-Vascular Epiphytes and Shade Trees on Cacao Productivity in Central Sulawesi, Indonesia

Cacao (*Theobroma cacao* L.) is one of the world's most important cash-crops but little is known of mechanisms underlying it's fruit-set and yields. We hypothesize that cacao production depends on a complex, interdependent set of ecosystem services. We quantified the effects of herbivorous and pollinating insects, shade tree composition and non-vascular epiphytes on fruit-set and yield of cacao trees. We tested three hypotheses in case-studies where we combined approaches of plant and animal ecology. First, non-vascular epiphytes act as habitat for potential pollinating insects as well as for herbivorous insects. Second, epiphytes drain resources from the trees and inhibit cacao flowering mechanically. Third, different types of shade trees influence the densities of non-vascular epiphytes and of herbivorous and pollinating insects. The studies were performed in agroforestry systems with different shade tree compositions bordering to the Lore Lindu National Park, Central Sulawesi, Indonesia. We selected 80 trees at four comparable cacao-dominated agroecosystems to study the role of non-vascular plants. On 2500 flowers from 24 trees under different types of shade trees, pollination efficiency was quantified. At nine agroforestry sites, shaded by three types of shade-tree compositions, we studied the effects of shade trees on densities of herbivorous insects. In total, our methods included the monitoring of >5000 flowers, >1500 cacao pods of similar age and >150 cacao trees. This multidisciplinary approach with a broad data basis should give some evidence of the main drivers of cacao productivity.

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Temporal and Spatial Dynamic of Parasitic Hymenoptera in Cacao Agroforestry Systems

Agroforestry system has been known to play an important role in maintaining insect diversity. In cacao agroforesty systems, the abundance, diversity and population dynamic of insects can be effected by the distance of the cacao plantation from the remaining forests. The objective of this study was to evaluate the effect of increasing distance from forests on parasitic Hymenoptera assemblages. A gradient of increasing isolation of cacao agroforestry systems at the eastern margin of the Lore Lindu National Park, Palolo Valley (Central Sulawesi, Indonesia) is selected as the study sites. Twelve cacao plantations at varying distances (10-220 m) to remaining forest and two cacao plantatitons inside the were selected. Additionally to cacao canopies in 14 selected cacao plantations, the tree crowns of small understorey forest trees were sampled. At each site, five trees were selected and Hymenoptera were collected from the canopies by treating them with a knock-down insecticide. The twelve cacao plantations were sampled three times (June 2001, August 2001, February/March 2003) to study the temporal dynamic of communities of parasitic wasps. On a small temporal scale, we found significant differences of abundance and species richness of parasitic Hymenoptera between samples from June and August 2001 indicating that the re-colonization of the sprayed cacao trees was still in process after 2 months. No differences in abundance and species richness were found between samples after a re-sampling of the same trees 1.5 years later. However, a significant difference with respect to the species composition indicated a pronounced temporal species turnover. Due to the long recovery period of communities of parasitic Hymenoptera the treatment of cacao trees with insecticides can significantly decrease the effectiveness of these important parasitoids to control herbivores in cacao agroforestry systems.

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Managing Agroforestry Systems for Sustainable Livelihoods in the Bufferzones of the Kerinci Seblat National Park, Kerinci District, Sumatra

Agroforestry systems, which imitate a forest structure and incorporate economic valuable perennial crops, seem to have much to offer in integrating ecological and socio-economic benefits to stabilize ecosystem functioning and the conservation of (a certain degree of) biodiversity in forested tropical landscapes. In addition, dispersed tree systems may have similar socio-economic benefits, but far less environmental benefits. Still, these systems are considered to be superior to purely agricultural croplands. Especially in the forest margins, a specific mixture of trees and agricultural crops may provide important corridor functions for migrating fauna. As most studies dealing with a sustainable management of forests and tree-based systems in the margins of ecologically vulnerable areas are strongly pre-occupied with the conservation of the natural environment, such environmental benefits are quite well documented. Many of these studies assume a direct causal relationship between the incorporation of economic valuable perennial crops and the achievement of socio-economic benefits. They rarely seem to question to what extent they can actually integrate objectives of sustainable management of natural resources and socio-economic improvements for a increasingly heterogeneous socio-economic pattern of the managers, the farming households, who aim at livelihood stability in the context of continuous stresses and shocks, caused by a growing integration into national and global economic and social processes. Reconsidering this link between livelihoods, forests and biodiversity towards a more holistic understanding of overall livelihood sustainability and resilience under the influence of these processes, reveals a more varied picture of the various benefits that these systems may offer. This is the focus of this study, which was done in three selected villages, located in the bufferzones of the Kerinci Seblat National Park, Kerinci District, Sumatra. Livelihood resilience and sustainability has been achieved by developing economic valuable multi-strata agroforests, as well as by dispersed tree systems, both in a mutual relationship with rice cultivation and other, off-farm options. As the study covers the period of the economic crisis and its aftermath (1997-2003). it enabled a cross-system analysis of the stability of the different tree-based systems and thier components mentioned earlier in the context of contributing to livelihood sustainability under periods of stresses and shocks.

This paper demonstrates that due to the advancing processes of globalization and commercialization, forest and tree management are more than ever before an integral part of the overall coping and adaptive mechanisms of individual households. The success of these mechanisms tend to vary, largely depending to

what extent households are able to secure or accumulate access to different kinds of vital resources, of which natural resource management is one, but incresingly no longer the only option to achieve a sustainble livelihood. Non-farm activites may increasingly add to the sustainability and stability of forest and tree managmnet practices. As such, a heterogeneous pattern of management among different socio-economic groups has been identified in the resarch villages, each showing ecological and socio-economic benefits and constraints. It will also be argued, that through a lack of superior alternatives of investing earnings other than in the expansion of commercial upland tree-based systems, the conversion of forests is as much threatened by wealth as by poverty. It proves that poverty and deforestation are not necessarily, and increasingly no longer exclusively linked in a downward spiral. The idea of protecting the remaining forest through economic development by rising the farm incomes may in fact accelerate the process of deforestation. In this context, paying farmers for environmental services, a hot issue in the international debate on the conservation of rainforest margin areas or nature may fail for similar reasons. Any improved management system must be based on a thorough knowledge of how global, national and regional processes and interventions affect natural resource management decisions at the household level in the context of overall livelihood sustainability.

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Community Conservation Agreements and Conservation: Legal, Economic and Organisational Constraints

1. Legal framework

In general, the most outstanding finding is that laws related to NRM and forestry offer less opportunities for local communities to manage their resources autonomously as it is the case with other legal devices regulating regional economy, family welfare and national development. In other words: In devolving authority in NRM to local communities; laws regulating resource use in indirect manners are much more relevant than laws regulating NRM in direct manners. Further, in all forestry laws and regulations, devolution of authority remains confined to so-called customary (adat) communities; leaving almost no chances for communities which either lack the necessary proofs or which are ineligible for customary community status (i.e. transmigration sites). In emphasising the management capabilities of adat institutions; other criteria such as security and social stability are not recognised as decisive factors of devolution by any law regulating NRM. The situation for local communities improved with Kpts DJ-IV/2000 which established the legal base for the creation of a "traditional utilisation zone" in National Parks.

2. Implementation of CCA in the five "pilot villages"

Three of the five pilot villages in Napu have been chosen on the basis of population size, two on the basis of the age of settlement. The "village sampling" still perceived the village as an isolated entity in dealing with TNLL and was thus hampering the formation of village alliances from the beginning. The possibility of using resource entities beyond the village as CCA targets has been pointed out by the lawyers who tried to legalise the CCA; but their legal opinion was asked only after the CCA had already been "socialised" and "agreed upon" in the villages. As it was the case with the zonation, once again TNC worked under massive time pressure. The process, driven by a motivation for fast action, suppressed differences in interest in favour of consensus, and fast action was given priority over a detailed design acknowledging the coexistence of different interests between the stakeholders involved.

3.Implemenation Disaster: The case of Watumaeta village

Since years the village claimed parts of TNLL as customary land (tanah adat) which should be divided between land less local families. Thus from the beginning, the CCA was perceived as an answer to the land access problem, not as a means of conservation. The problem was enhanced because at the same time the CCA was facilitated in the village, the forest department organised an inquiry

concerning major tree crops needed in the village. Thus once again, the CCA was mixed up with another issue, enhancing unrealistic expectations about CCA, leading to strong rejections of the agreement when it turned out as a pure reforestation program. Two trees occurring naturally in TNLL should be planted, candle nut at the border of the Park; and "leda" inside plots already opened. Candle nut had been planted in 4 rows, 2 inside the Park and two outside, the former envisaged to be used to cover operational costs of monitoring, the latter to benefit the owners of plots adjacent to the Park. Not being explained to the villagers, this was perceived as a move of the park border, leading again to negative opinions of CCA.

The right to monitor CCA was vested in a new organisation (LKD) which was created especially for this task by TNC. (Because LKD only monitors TNLL; in some villages CCA increased the pressure on the protection forest, leading to severe problems of erosion and water supply). Because the LKD co-operates directly with the Park rangers, the village head was totally sidelined in the re-planting operation with the effect that he is not willing to handle any conflicts related to CCA. In formulating the rules and sanctions related to CCA, village leaders were not free to express their aspirations, because of the presence of "mind guards" in the form of TNC members and Park rangers during the sessions. Concerning the re-planting, only the procedure was discussed and that "leda" should be planted. Similarly to the planting of candle nut; it was believed that "leda" will be planted on the fringes of the plots. There was no discussion of the planting pattern. It was only after the CCA was signed, that it turned out that "leda" should be planted 5 x 5 meters in peoples plots and it was not before this time that people realised that the CCA actually means the destruction of their cocoa plots in the forest without provision of any economic substitute. Thus the major problem between the community and the state "socio-economic security" versus "common interest of conservation" was not solved by CCA; but seems rather to be enhanced one again due to non-transparent and too fast implementation

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How many Forest Mammal Species Dwell in Rubber Agroforests? A Local Ecological Knowledge Approach to Rapid Mammal Diversity Appraisal

In order to assess the role played by rubber agroforests in the conservation of forest mammals, local farmers and hunters selected for their expertise were interviewed about mammals encountered in rubber agroforests. Interviews were carried out during observational walks and later in the villages with the help of photographs to identify species. Similar surveys were conducted in 5 rubber agroforest-dominated landscapes with differing connectivity to remnant patches of natural forest and in 2 biologically depauperated landscapes dominated by monoculture plantations of rubber and oil palm in the Bungo district, Sumatra. In a second stage, close-ended interviews were conducted with randomly selected farmers in the first 5 sites to cross-check the validity of data collected during the first step.

Despite some identification problems with nocturnal species which our informants were apparently not familiar with, overall trends are very clear showing that rubber agroforest contribute significantly to the maintenance of a large range of mammal species in the area. As many as 37 species (as compared to the 85 mammals species known to be dwelling in the nearby Kerinci park which encompasses a much wider altitudinal habitat range) were recorded to use rubber agroforest as an alternative habitat to the rapidly exhausting natural forest. Among those, 6 are believed to strongly rely on neighbouring forest and to use agroforest only as an occasional extension to their feeding range. In marked contrast rubber monoculture plantations and oil palm plantations are inhabited by only 2 and 4 mammal species respectively.

The interviewees also hint that current high hunting pressures on selected species in response to market demand, may threaten their long term survival. Taken together those results confirm the potentially important role rubber agroforests may play in the conservation of wild animals in the area but also stress that specific action will be needed to protect some commercially hunted species which appear to be presently endangered.

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Alternatives to Slash-and-Burn in Forest-Based Fallow Systems of Eastern Amazonia: Ecological Necessities, Agronomic Possibilities, Economic Limitations and Policy Measures

In forest-based fallow systems of the humid tropics, the slash-and-burn practice is widely used for land preparation. Increasing land-use intensity and retaining the slash-and-burn practice leads to the degradation of the fallow system's natural resource base: soils and fallow vegetation. Therefore, in the eastern Amazon region, we searched for ways to maintain the sustainability of the traditional fallow system and to adapt it to changing agroecological and economic conditions.

Initial studies focused on both the fallow vegetation and the fallow system as a whole. In the fallow vegetation, we carried out vegetation surveys, biomass studies und studies on the regeneration capacity of the fallow after harvest and abandonment of the fields. Regarding the fallow system, we studied nutrient fluxes and changes in the soil properties during the fallow as well as the cropping period. All field studies were conducted on smallholders' lands. Based on our findings and with farmers' help, we identified two major constraints of the fallow system with slash burning: (1) loss of nutrients and organic matter during the burn and (2) with increasing land-use intensity, declining fallow biomass and nutrient accumulation during the fallow period. Instead of designing an entirely new land-use system, we only studied modifications to those practices recognized to be harmful to the sustainability of the fallow system itself. These modifications include mulch technology for the management of soil organic matter and fire-free land clearing with bush choppers to transform fallow vegetation into mulch. Seven chopper types with different chopping capacities (0.25 and 25 tons fresh biomass per hour) were tested. The mechanized chop-and-mulch technology can be applied to fallow vegetation that is up to 25 years old, which corresponds in the study region to up to 300 tons fresh biomass per hectare. In the context of mulch technology, crop cultivars were screened under mulch conditions and their response to fertilizer was studied (mulching with wood chips requires fertilization). Furthermore, the mulch technology allows extending the cropping

period, planting crops off-season (fire-free land preparation is not restricted to the dry season), and modifying crop rotation. Biomass and nutrient accumulation of degraded fallow vegetation were improved by enrichment plantings using fast-growing leguminous tree species.

In a participatory approach, we collected farmers' reactions to the chop-and-mulch technology. Scenario analyses using farm-level bio-economic modeling techniques have shown that countervailing policy measures are necessary if mechanized chopping and mulching is to bring about the desired ecological benefits. Costs of mulching are still high compared to other mechanized land preparation technologies that provide similar economic benefits from the farmers' point of view. Taxes on ecologically undesirable forms of land preparation, e.g. slash and burn, are promising policy options to promote the chop-and-mulch technology. The model suggests that tax revenues can be used for financing environmentally friendly land-use practices. Moreover, it can be shown that technology-specific crop yield insurance would make mulching more interesting for farmers that rely on slash and burn as production risks through the use of mulching would be reduced .

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Response of Cryptogamic Epiphytes to Forest Modification in the Tropics

In temperate regions, cryptogamic epiphytes (bryophytes, lichens) are known to respond very sensitively to environmental changes and are frequently used as ecological indicators. In the tropics, the dynamics of these epiphytes has hardly been investigated. We sampled cryptogamic epiphyte assemblages in primary and recovering forests and on remnant trees at different sites and elevations in tropical America. Total species richness in primary and old secondary forests did not differ significantly, showing that primary forests are not necessarily more diverse than secondary ones. In young primary forests and on remnant trees, however, species richness was reduced. Moreover, cover of epiphytic lichens was significantly increased on remnant trees, that of bryophytes significantly reduced. Canopy closure and atmospheric humidity proved to be important parameters determining the responses of cryptogamic epiphytes to environmental changes. Similarity in species composition of secondary and primary forest increased with forest age, but after 40 years of succession about one fourth to one third of the primary forest species had not re-established in secondary forest. Community composition in primary and secondary forests also differed markedly, indicating that long time is needed for re-establishment of bryophyte species and communities in the regenerating niches. Genera and species exclusive to primary forests are relevant as indicator taxa and conservation targets. The "moss-lichen quotient" is presented as a new tool for bioindication of forest modification in the tropics.

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Impact of Socio-Economic Factors on Crop Diversity in Homegardens of Central Sulawesi, Indonesia

Homegardens are generally regarded as a very complex, species-rich agroforestry system managed in a sustainable manner. In addition to their important ecological, social, and cultural functions, homegardens contribute to food security and income generation. This is based on their high diversity in useful plant species. Homegardens are, therefore, also considered as a model for in situ conservation of plant genetic resources. However, little is known about the dynamics of plant diversity over time and factors causing changes or stability. This study aimed to assess crop diversity and its dynamic over a period of three years as well as influencing factors on it, focusing particularly on socio-economic characteristics.

In 30 homegardens randomly selected from three villages in Central Sulawesi, diversity parameters of useful plants (species number, density, abundance, Shannon index) were assessed in 2001, 2003, and 2004. The same parameters were studied in 20 homegardens selected from two additional villages of the same area only in 2004. Data concerning socio-economic characteristics of households were gathered through individual interviews of the gardeners.

In the 30 homegardens studied from 2001 to 2004, total number of useful plant species was high and increased over time from 152 to 178. Similarly, all diversity parameters increased in the same period. Principal Component Analysis of mean species abundance in 2001, 2003, and 2004 showed different trends in the three villages. In a remote village species composition was fairly stable over time, whereas in two villages with rather good market access obvious changes occurred, mainly because cash crops like vanilla and cacao increased in proportion. Crop diversity was markedly lower if the production was rather market- than subsistence-oriented. Multivariate analysis of crop species composition and abundance in all 50 homegardens showed clear differences between gardens managed by migrant or indigenous families. Moreover, all diversity parameters were lower in migrant gardens. Regression analysis demonstrated that out of the socio-economic variables tested, mainly commercialisation, gardeners origin and wealth status, as well as market access influenced crop diversity. In addition, factors describing garden features, like soil fertility and garden size, affected crop diversity.

In conclusion, diversity of useful plants was not only influenced by certain socio-economic factors, but also by garden characteristics. Diversity was fairly dynamic over time, particularly when commercialisation was possible. Under these circumstances, the general suitability of homegardens for in situ conservation of plant genetic resources seems questionable.

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Agroforestry in the West African Forest-Savanna Mosaic: Consequences of Low- and High-Intensity Land Use on Phytodiversity and Landscape Dynamics

In the Guineo-Sudanian transition zone of West Africa, semi-deciduous forest islands are interspersed in mostly anthropogenic savanna. Their high biodiversity is an important natural resource that nowadays is subjected to increasing land-use pressure and climate shifts. Agriculture is preferentially carried out in the vicinity of forest islands and in their boundary zones. The practices of traditional low-intensity and recent high-intensity agriculture were studied in the drier north and the more humid center of Ivory Coast. Their effects on diversity, regeneration and dynamics of semi-deciduous forests were investigated by direct comparison of protection areas (Comoé National Park and Lamto Reserve) with adjacent agriculturally used land (interdisciplinary BIOTA Africa program, supported by the German Federal Ministry of Education and Research).

Floristic diversity, biomass and regeneration were studied along forest-savanna transects, past and present land use practices and ethnobotanic customs were interrogated with polls among the inhabitants, and forest-savanna dynamics were analyzed with remote sensing data.

In both study regions, forest-dwelling Rubiaceae dominate on young fallows also in savanna areas, indicating a high regeneration potential of forest species at first. Here, total species diversity is comparatively high under low-intensity agriculture – especially in the more humid Lamto region –, but only half as high under intensive land use due to the elimination of woody species. The cash crops cashew in the Comoé region and cocoa and coffee in the Lamto region are nowadays commonly planted with the field crops, leading to a repression of fallow regeneration and a decline of arable and forested land, i.e., to a decline of the traditional subsistence farming.

Corresponding forest margins in the protection areas show a distinct zonation of species regeneration from the forest interior via the forest belt into the adjacent savanna, indicating a successional encroachment of forest onto savanna with a concomitant doubling of species diversity. This process, however, was found to be very slow in the drier Comoé National Park region: Aerial photographs revealed that the contours of 95% of 653 forest islands remained virtually stable between 1954 and 1996, allowing for a maximal advancement of the forest borders in the field of a few meters only. This also applies to the exterior of the national park

that was weakly populated (10 inhabitants/km²) and traditionally utilized. Today, however, more rapid cultivation cycles and selective logging cause an increasing fragmentation of forest areas and a dominance of successional thickets thereon (Landsat-image change detection). Many species of intact forests now can only be found in a few separated stands, in particular in the protection areas.

Basal area and phytomass in the Comoé savanna and at forest margins were significantly raised by the presence of a few distinctively large tree individuals that contribute to the total values of a relevé plot by up to 89%. Only species protected (and used) through local traditions are represented by these old-grown individuals.

These facts can be used for directly sensitizing the local inhabitants for a more sustainable land management. The planting of cash crops should be reduced to avoid an elimination of intact forests and a considerable reduction of arable land. Even under extensive land use, the forest-island pattern has been stabilized by annual savanna fires, which might apply to many other tropical regions. However, future land use must strictly allow for the high potential of forest regeneration and an enforced protection and connectivity of intact forests.

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Recovery of Tree Diversity Mediated by Birds in Forest and Agroforestry

Due to the accelerating loss of biodiversity related to rainforest habitats conservation strategies must focus in the last remnants of pristine forest, but should also consider the conservation value of forested agricultural lands. We investigated the potential role of intervened forests, abandoned and managed agroforestry types in protecting tree diversity and tree recovery from seeds in the Chocó region of coastal Ecuador where only small patches of forest remained in an agricultural matrix. The Chocó region is considered one of the biologically most diverse areas in the world, even though vast areas of natural forest have been displaced by crops and cattle grazing, some of them were abandoned after few years of use.

We studied species richness, floristic composition, and population structure in intervened forest, 12-15 yr-old abandoned coffee and actively managed coffee agroforestry. In addition to tree diversity, we analyzed the role of these land-use types for forest recovery assessing the diversity of saplings and seedlings. Bird species richness and abundance was also recorded in all sites. To evaluate the role of birds as dispersal vectors in this mosaic landscape, we sampled bird faeces in all study sites. Furthermore, we investigated the potential role of several habitat parameters (i.e., light intensity, weed abundance, canopy structure and seed dispersal by birds) in forest recovery. Tree species richness was similar among the three selected land-use types while sapling and seeding species richness was significantly higher in abandoned coffee than in managed coffee or forest sites. Abundance-based Jaccard index of all pairwise comparisons showed that floristic composition of seedlings was similar between intervened forest and abandoned coffee while that of coffee agroforestry was significantly different. Although habitat parameters and seed dispersal (refer as the number of dispersed seeds found in each study site) were similar among land-use types; they significantly affected seedling and sapling species richness and composition. While species richness was positively affected by the number of dispersed seeds, canopy cover had a negative effect on it.

We conclude that intervened forest and abandoned coffee appear to have a similar conservation value for plant diversity. The high diversity and abundance of seedlings and saplings may indicate a similar pattern of forest recovery among these land-use types, while the lower values found in managed coffee agroforestry

is due to stronger human interference, mainly the manual removal of weeds and seedlings. However, tree diversity appears to be better preserved in managed agroforestry systems than in abandoned coffee or even forest, since several species common to mature forest were only recorded in managed coffee sites. Our results show that intervened forest and abandoned coffee may greatly contribute to tree recovery with birds as important dispersal agents of tree seeds.

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Co-Management of Protected Areas, the Case of Community Agreements on Nature Conservation in the Lore Lindu National Park, Central Sulawesi-Indonesia

State-based management approaches to nature conservation have often failed to balance the goal of conservation and the goal to improve the livelihoods of local communities, especially in developing countries. Against this background, community agreements on conservation - as a co-management strategy for protected areas - have a considerable potential for dealing with conflicting interests of diverse stakeholders concerning protected area management. As such agreements are locally negotiated, they can take the specific ecological, socio-economic and cultural conditions at the local level into account. However, locally negotiated agreements cannot be regarded as a panacea to the problems of nature conservation since an effective government support and the participation of all interests groups have to be ensured. The political frame conditions and the roles played by different non-governmental organizations (NGOs) and village leaders have a crucial effect on the success of conservation agreements, as well. The present study analyses community agreements on conservation from an economic and political perspective, taking the case of the Lore Lindu National Park in Central Sulawesi, Indonesia, as an example.

The analysis of the community agreements in the Lore Lindu National Park characterize the approaches applied by different NGOs to establish conservation agreements and the identification of the factors that affect household participation in the process of negotiating the agreements. The strategies of the following three NGOs were investigated: (1) YTM (Free Earth Foundation), a local advocacy NGO, (2) TNC (The Nature Conservancy), an international conservation NGO, and (3) CARE, an international development NGO.

A combination of empirical research methods has been applied such as stakeholder interviews at provincial and village level with snow ball system method. A household survey focused on selected 200 respondents, who were randomly selected from households whose do not have official functions in 6 selected villages where a conservation agreement has been signed. The study presents a qualitative and a quantitative empirical analysis of the establishment of conservation agreements. A qualitative analysis is applied to analyze the strategies applied by different NGOs in promoting community agreements on conservation in area of the Lore Lindu National Park. The quantitative analysis is based on a PROBIT model to determine factors influencing participation.

The results of the study show that the co-management agreements constitute an interesting and instructive example of natural resource management. Due to their voluntary character, they have the potential to reduce conflicts and problems inherent in the command and control approach of the state agencies. Making sure that the interests of different groups within communities are adequately considered in drafting the agreements remains an important challenge. With regard to the strategies applied by different NGOs, the results showed that YTM has a strong expertise in advocacy for indigenous rights, TNC has a strong expertise in protecting nature, and CARE has a strong expertise in promoting rural development. It was concluded that these NGOs will have better opportunities of combining their unique strengths in the future by working together and coordinating their activities.

In order to identify the factors determining the participation of households in establishing the agreements, the PROBIT model findings show that more wealthy people are not more likely to participate in the negotiation process, since the coefficient of the UPL_CULT is not significant. However, people with more social relations in the village (indicating social capital) and better access to political decision-makers (indicating political capital) were more likely to participate with t-test significant at the 1% level of error probability. Similarly, well-educated and older people (indicating human capital) were more likely to be involved with t-test significant at the 5% level of error probability. On one hand, this represents a good opportunity for communication and provision of feedback. However, on the other hand, these results suggest that socially disadvantaged and politically less connected villagers may be excluded from negotiation. In conclusion, the study showed that community agreements offer a considerable potential for reaching ecological goals, but attention has to be paid to take into account the interests of disadvantaged community members, who depend on natural resources for their livelihoods.

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A Manual for the Sustainable Use of Silvopastoral Systems in the Bolivian "Subandino"

More than 60% of the territory of Bolivia is used as grazing area for livestock. In the "Subandino", most of the land which is not used for crop cultivation, is used as pasture land, including the natural subandean forests. A sustainable management of these forests is of fundamental importance to guaranty the long-term well being of both the local population and the ecosystem. To date, little is known about the feed-selection of livestock in the subandean forest. Consequently, the effects of cattle grazing on the forest and on the herbaceous vegetation are unknown. Zones of transhumance are apparently those most infested with the toxic Pteridium aquilinum (Kuhn western brackenfern). It is thought that this toxic plant species is the cause of the high cattle mortality (up to 9% per year) in the subandean region of Tarija, Bolivia.

The final objective of the project is to create a manual for the sustainable use of silvopastoral systems in the Bolivian Subandino. The project has the following specific goals:

- Understand the intensity of the use of certain plant communities for cattle grazing

- Characterize and evaluate the most frequent foraging plants, herbs, bushes, and trees according to their nutritive value, availability, and preference

- Analyse the nutritional composition of cattle diet and determine the digestibility of forage

- Determine the effect of grazing cattle on the state, development, and regeneration of plants

- Develop guidelines for the sustainable use of silvopastoral systems in the Subandino

In each study area, the intensity of grazing ("Tropical Livestock Unit"=TLU) was registered. This was accomplished through direct observations and interviews with land owners. Plant species selection by cattle was assessed by direct observations and microhistology. To analyse the effect of cattle grazing on biodiversity, the number of plant species in distinct areas used for cattle grazing at different stocking rates were compared. In order to assess the feed selection of the cattle in

the forest, direct observations were applied. The influence of different intensities of grazing and browsing on the most important foraging plants (herbs, bushes, and trees) was registered comparing the state of the plants before and after grazing. Of the plant species browsed or grazed most intensely, samples of the parts of the plant typically consumed by the cattle were taken and the following components of those samples were analysed: protein, fiber (NDF and ADF) and tanins (especially in the species Prosopis and Acacia) in order to asses their nutritional value. To analyse the digestibility of certain plant species, the HFT-test was applied. Based on the results a manual for the sustainable use of silvopastoral systems in the Bolivian Subandino will be written.

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Diversity and Density of Palms and Rattans in Primary Forest, Old Secondary Forest, and Recent Established Traditional Cacao and Coffee Gardens in Central Sulawesi, Indonesia

Species diversity and density of palms and rattans were studied in four rectangular plots of 50 m by 50 m each in primary forest, old secondary forest, and recent established traditional cacao and coffee gardens at 800 – 1200 m elevation at Desa Toro in and around the Lore Lindu National Park area Central Sulawesi, Indonesia. Diversity and density between primary forest and old secondary forest are rather similar but are dropped very sharply in the recent established traditional cacao and coffee gardens. However, the diversity and composition of the palms and rattans species in each plot are diverse. Those diversity and composition at Desa Toro will be compared with that of other localities in Sulawesi. In addition, a utilization and conservation of rattans in the area will be addressed.

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Consequence of Rainforest Conversion with Different Land Uses Types for Soil Erosion and Surface Runoff in Nopu Catchment, Central Sulawesi

This research was carried out to study soil erosion and surface runoff dynamic due to conversion of tropical rainforest margin to agricultural practices in Nopu catchment of Central Sulawesi province. Rainfall event based soil erosion and surface runoff was observed on land use type of natural forest, slash and burn, scrubs, cacao plantation, vanilla plantation, and bare land.

Comparing with natural forest cover, the rate of soil erosion on bare land, slash and burn, cacao plantation, scrubs, and vanilla plantation were increased with 3,619%, 1,423%, 987%, 268%, and 212% respectively. It was measured for one maize season planting (4 months). Meanwhile, comparing with mature cacao plantation (10-12 years old), the soil erosion rate was increased with 81% on medium cacao plantation (4-5 years old), 77% on intercropping of young cacao plantation (2-3 years old) with cassava and maize, 60% on hybrid maize planted monoculture, 31% on young cacao plantation, and 14% on intercropping of medium cacao plantation with banana. The soil erosion rate was increased by 29.8% on mature cacao plantation when the slope inclination increased from 9% (flat) to 42% (steep). Results show therefore significant influence of slope angle, crone covering and changements of soil surface structure.

Decreasing of soil permeability due to the conversion forest cover was the main factor of incremental surface runoff. The increments were 171%, 44%, 28%, and 27% on bare land, cacao plantation, slash and burn, and vanilla plantation respectively. While on steeper slope, the surface runoff was increased 161% on bare land, 44% on medium cacao plantation, and 35% on slash and burn area. On the contrary, the surface runoff was decreased 30% on scrubs and 10% on intercropping of young cacao plantation with cassava and maize. Intercropping can reduce significant surface runoff and soil erosion, whereas sediment concentration is still high.

Comparing with mature cacao plantation, the sediment concentration was increased 319% on bare land, 169% on monoculture planted maize, 87% on intercropping of young cacao plantation with cassava and maize, 51% on young cacao plantation, and 30% on medium cacao plantation. The sediment concentration, however, was decreased 46% on scrubs and 43% on vanilla plantation compared to mature cacao plantation.

First results (plot measurements since September 13, 2004) show average soil erosion of magnitude for intensive rainfall events of 2.27 t/ha for bare plot, 0.11 for maize plot, 0.08-0.17 for cacao plot in relation to forest plot (0.03 t/ha). Conclusions for land use types with minor erosion risk can be derived for the converted rainforest catchment areas in Central Sulawesi.

The strong correlation of incremental surface runoff and its sediment concentration in line with incremental of pollutant dissolved in the sediment due to forest conversion would be the threat of land resource and environment sustainability.

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Access to Credit, Land Use, and Environmental Degradation: Empirical Evidence from the Rural Areas in the Vicinity of Lore Lindu National Park

Particularly in rural areas, the role of credit markets has become important in terms of the problem of environmental degradation. A number of recent studies have assessed the impact of access to credit on household income and consumption. However, there are only a few studies that analyze the relationship between access to financial services and environmental degradation. Better access to financial services can reduce the pressure on natural resources. Infrastructure development and access to global markets, especially the export market for cocoa, have led to a far-reaching transformation of land use systems practiced by the diverse ethnic communities in the Lore Lindu area. The cocoa boom has led to increased migration, mostly of Bugis from South Sulawesi to the research area, and to the occupation of large land areas by wealthy citizens from the district capital.

This paper addresses the question of whether greater access to financial services reduces the overexploitation of natural resources. Specific research questions addressed are as follow: (1) How many households have access to formal credit markets? (2) How many households are credit constrained? (3) What factors influence that households are credit constrained? (4) How does credit rationing influences the households' decision to allocate land to cocoa and coffee in the uplands?

As many studies have shown, many rural households lack access to either formal or informal credit institutions. In the vicinity of the Lore Lindu National Park only 21.5% of the households have access to formal credits. The results also show that under certain conditions, only 18.1% of the households are not credit constrained. Most households are credit constrained due to a lack of collateral and because of the self-selection problem. The share of households growing cocoa and coffee in the uplands is significantly higher among non-credit constrained households (52.8%) compared to credit constrained households (47.1%).

The econometric analysis consists of two parts. The first part explores the determinants for a household to be credit constrained, focusing on the formal credit market by using a Probit model. In the second part of the analysis, we investigate the influence of being credit constrained on land allocation in the upland areas by applying a switching regression model. The results of the Probit

model show that human capital (i.e. education and age of the head of household) as well as wealth and risk-bearing indicators are significant in determining whether a household is credit constrained. The results of the switching regression model suggests that households which are credit constrained behave differently than those who are not credit constrained in making decisions on land use for cocoa and coffee.

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The Role of Meteorology in Sustainable Development of Nigeria in Conflict Management in Community Forestry

Weather and climate are significant factors that significantly affect man-environmental systems, and in particular almost all human activities. West Africa and Nigeria. In particular has undergone extreme climatic variability, weather and climatic variations especially during the past four decades [Ojo 2000]. The term sustainable development applies to progress in which activities are under taken to meet present needs but which do not have negative impact on the ability of succeeding generations to satisfy their own needs. For example indiscriminate use of water and its pollution from various sources may affect the quantity and quality of water to the extent that the next generation may not be able to satisfy its basic water need.

In the context of Nigeria whose present core exports are petroleum products, the major challenges related to sustained development in the early years of the new millennium will be, among others, the fast-growing population and the associated increasing demands for basic needs such as water, food, energy and shelter. Other challenges include political stability, globalization and marketed economy, development in science and technology and the capacity to absorb and utilize the appropriate, natural disasters, especially the impacts of extreme weather and climate events such as floods and drought, desertification and other environmental degradation processes, and climate change and its impacts. While forest plays very important role in the life of rural community dwellers in Nigeria. Their sustenance defends largely on it. Unfortunately, there has been serious degradation of the forest especially by other stakeholders outside the forest. There is now the call to invoice the local Communities in forest management in return for a share of the benefits accruing from such activities. Accommodating the needs of the rural poor with those of other stakeholders in forest resources management and utilization normally engender conflicts. In this paper, the causes of these conflicts are enumerated. Strategies are proposed on how to resolve the conflicts. A key highlight of he paper is the emphasis on the need for capacity building among all stakeholders so that they cam implement the conflict management strategic by themselves.

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Economic Valuation of Pollination Services and Pest Management Comparing Coffee Landscapes in Ecuador and Indonesia

Biodiversity conservation through land-use systems on private land is becoming a pressing environmental policy issue. Agroforestry like shade-coffee production is known to contribute to biodiversity conservation. However, falling coffee prices and pest problems force many coffee growers to convert their sites into economically more attractive land uses. We show results of an economic evaluation of coffee bee pollination and pest control in two distinct tropical regions: a low human-impact area in Indonesia with forests neighboring agroforestry and a high-impact landscape in Ecuador with almost no forest left. We evaluate bee pollination comparing forest destruction scenarios, where coffee yields depend on forests providing nesting sites for bees and present three novel approaches: first, we show how coffee revenues depend on pollination services of adjacent forests considering berry weight in addition to fruit set, thereby providing a more comprehensive valuation. Second, we combine our findings on pollination with an evaluation of pest management affecting coffee production. Third, we determine net welfare effects of land-use changes including the fact that former forestland is normally used for alternative crops.

As a natural habitat of bee populations, forests provide pollination services to adjacent coffee areas. The value of these services can be determined by comparing forest destruction scenarios with a reference situation, where coffee yields depend on the distance to forests. We found that the main economic impact, measured as net revenues per ha, takes place within a distance of 400 m to forest patches, and is highly influenced by the management system. Our Indonesian case study shows a moderate decline of net coffee revenues due to an extensive management system. In Ecuador, a more intensive coffee management including a higher percentage of fixed costs causes a steep decline of net revenues when adjacent forests are destroyed. Nevertheless, the absolute value of pollination services is similar in both regions.

Our scenarios in both countries show that most land-use alternatives generate higher net revenues per hectare than the value of pollination services assigned to the deforested area. Consequently, from a private landowner's point of view, there is a strong incentive to convert forests into cropland. Even a payment for

ecosystem services, if based on pollination services, only, would hardly be sufficient to reduce pressure on forest margins. However, further ecosystem services provided by the forest, like biodiversity and soil conservation, should be taken into account, when deciding in favor or against forest conservation.

The production of certified "organic coffee under complex shade" shows a possible solution for coffee growers confronted with the impact of adjacent forest sites destruction, infestation problems and falling world coffee market prices. Certification norms include the selective harvesting of ripe berries, the collection of overripe berries fallen off the plant and the recycling of production residuals in form of organic fertilizer. In comparison with traditional production systems, these special management norms generate higher costs, but at the same time yields and revenues can be increased. Additionally, coffee growers become members of a cooperative and improve their bargaining position on the coffee market by breaking up the monopsonistic market form. Direct access to the world market by excluding intermediate traders in combination with an elevated consumers' willingness to pay for "biodiversity-friendly" coffee provides the basis for higher farm gate coffee prices. These, in turn, would generate incentives for landowners to maintain their shade-coffee production systems and to conserve their ecological functions within a landscape mosaic, which are of special importance in highly fragmented areas where only small patches of natural forest remain.

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Tree Diversity in Six Land Use Types Differing in Use Intensity in Central Sulawesi, Indonesia (1)

Within the framework of the STORMA project ("Stability of Rainforest Margins in Indonesia", funded by the German Research Foundation) in Central Sulawesi, Lore Lindu Park area, we studied tree diversity in six different land use types differing in use intensity: " Wana" (A; undisturbed forest), "Pangale type 1" (B; lightly disturbed forest), "Pangale type 2" (C; moderately disturbed forest), and three types of cacao plantations (D: "Pahawa pongko type 1;" E: "Pahawa pongko 2;" and F: "Huma"). Trees (dbh > 10 cm) were sampled in twenty four plots of 0.25 ha in all six land use types (4 replicates each). Identification of vouchers and additional herbarium specimens was done in the field as well as at Herbarium Celebense (CEB), Tadulako University, and Herbarium Bogoriense (BO), Bogor.

The results showed highest values of tree species richness, tree basal area, tree individual number, and Shannon-Whiener index of diversity in undisturbed forest. Diversity values decreased along the use intensity gradient, going from land use type B to F. Furthermore, significant differences were observed in tree species composition and predominant species among land use types.

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Tree Diversity in Six Land Use Types Differing in Use Intensity in Central Sulawesi, Indonesia (2)

Within the framework of the STORMA project ("Stability of Rainforest Margins in Indonesia", funded by the German Research Foundation) in Central Sulawesi, Lore Lindu Park area, we studied tree diversity in six different land use types differing in use intensity: " Wana" (A; undisturbed forest), "Pangale type 1" (B; lightly disturbed forest), "Pangale type 2" (C; moderately disturbed forest), and three types of cacao plantations (D: "Pahawa pongko type 1;" E: "Pahawa pongko 2;" and F: "Huma"). Trees (dbh > 10 cm) were sampled in twenty four plots of 0.25 ha in all six land use types (4 replicates each). Identification of vouchers and additional herbarium specimens was done in the field as well as at Herbarium Celebense (CEB), Tadulako University, and Herbarium Bogoriense (BO), Bogor.

The results showed highest values of tree species richness, number families, tree individual number, and Shannon-Whiener index of diversity were found at forest type B and it followed by A,C, D, E and F. Where as the highest of Basal Area was found at the forest type A. Furthermore, significant differences were observed in tree species composition and predominant species among land use types.

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Beta Diversity of Rubber Agroforest Tree Flora in Sumatra

High floristic richness of traditional rubber agroforest has long been recognised. Their role as a refugium for many forest species facing lowland natural forest exhaustion in Sumatra has often been put forward.

However most published floristic surveys are based on a small number of plot inventories in a unique site. There is a possibility that despite their locally high floristic richness rubber agroforest may have low beta diversity : their composition being dominated by a relatively small set of species with large geographic range (i.e. low value species from a conservation perspective) typical of secondary vegetation.

Floristic inventories of tree saplings were conducted in 61 standard sampling units made up of small subplots laid along a 60m long transect. Sampling units were located in four village territories (a few km2 each) in Jambi province, Sumatra. Villages were separated by an average distance of 30 km .

Floristic similarity between sampling units was assessed by Jaccard index (proportion of shared species). 2D Multidimensional scaling plot in of the similarity matrix accounted for 77% of the total variance. Rubber agroforest sampling units clearly segregated by site, indicating that beta floristic diversity in rubber agrofrest is indeed significant.

We further tested by Monte-Carlo simulation techniques the statistical significance of the site factor by decomposing total diversity (either expressed as floristic richness, Simpson diversity or Shannon diversity index) into site and plot effect. Site effect proved highly significant whatever index of diversity was chosen.

It is concluded that the initial concern of low beta diversity in rubber agroforest is probably not justified. Current research focuses on establishing to what degree the beta diversity of rubber agroforest reflects the beta diversity of the original forest biome.

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Intensification Model for Cultivation System of Natural Feed from Anoa (Bubalus sp.) in Advance of Wildlife Conservation

The types of animal productions include extensive grazing systems on native grassland and upland forests and forest margins. But, it was not supported by the increasing of harvested area. Then, the increasing of crop productivity must be driven by technology innovation. In order that, the decreasing of Anoa's territory must be followed by its feed intensification. The research was leading to give basic information concerning of conservation and captivation of Anoa as an endemic and endangered animal from Sulawesi. Research was performed to be done as field research (Zone National Lore Lindu Park of Rain Forest in Central Sulawesi) and laboratory research in the laboratory of Forage Science, Animal Nutrition and Feed Science Department, Faculty of Animal Husbandry, Diponegoro University. The research was done from March-November 2004. Thirty sample plots were made by the size of 10x10 m. Nutrition content of the vegetation was analyzed by proximate analysis. Density and the amount of vegetation were determined by Odum's method. There are eleven identified vegetation which were desirabled by Anoa: Areca sp, Elatostema sp, Rubus sp, Zingiber sp, Nephrolepis sp, Cyrtandra sp, Begonia sp, Eragrostis sp, Saccharum sp, Kaloma (Fam. Palmaceae), Padalebo (Fam. Utricaeae). Refer to their nutrient content, it can be concluded that Anoa is well adapted to the feed which has high crude fiber content (20-45%) and relatively low protein content (5-13%). Moreover, Anoa's vegetation feed consist of plant which can be cultivated easily. An integrated of agricultural system was identified to be used for increasing the productivity. Mix-farming program is one of a good example of the agriculture ecosystem where human, animal, plant and land are place in which the natural biological process were done. It means that integrated farming system fits to be implemented in the developing countries such as Indonesia. This is in accordance with the income's source of people who lives around the rainforest margin which mostly being a farmer. In order to develop better land structure and texture, the management system of integrating agriculture and rain forest margin should be considered to be very important and has a strategic role.

A good socialization about Anoa's feed cultivation is hopeabled to help the wildlife conservation and to increase the economic growth for resident who lives around tropical forest and also preventing the resident to open the protected forest and hunt the Anoa wildly.

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Integral Use of three Arboreal Species - Brosimum alicastrum Sw, Hura polyandra Baill and Enterolobium cyclocarpum (Jacq) Griseb - in a Tropical Forest of the Coast of Jalisco

The use of trees and shrubs in the animal diet, is a common practice in subtropics and tropical zones, being an important resource of food for the cattle and wild fauna, mainly during the dry season, It is for that the objective of this study was to evaluate nutritious quality and diversity of uses of three arboreal species of the tropical forest in the Coast of Jalisco, Mexico. It was determined crude protein (CP), fractions of fiber: neutral detergent fiber (NDF) and acid detergent fiber (ADF), content of minerals and digestibility in vitro of the edible material of the species, being leaves and fruits mainly. The results indicate contents of protein of 22.2% for seed of Enterolobium cyclocarpum (Jacq) Griseb, and 15.36% for complete fruit of this same specie, in the Brosimum alicastrum Sw, consumed by different animal species, during the year, the highest value in protein was for the fresh leaves with (17.56%), obtaining the most minimum value the dry leaves of Hura polyandra Baill with 8.00% of protein. They dominate among others uses: timber-yielding, obtaining of nectar and pollen for the apiculture and medicinal. It is concluded that by their abundance, diversity of uses and nutritious quality of these species, they represent a sustainable and viable option for to be integrated in the silvopastoral systems.

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Can Introduction of High Value Timber Production Increase Rubber Agroforest Profitability and Help Stabilise Forest Margins in Sumatra ?

Sumatra rubber agroforests are traditional agro-ecosystems characterised by low input but also by low latex yield. They show high tree species diversity (typically more than 50% of trees > 10 cm dbh are non rubber trees) and are a refugium to many forest species both plant and animals. However they are slowly loosing ground partly because of their low profitability compared to current alternative land-uses. .

Strong demand for quality timber exists on both the local and the international markets and is likely to be sustained in the coming decades. As the natural forest source of supply is rapidly exhausting, farmers could benefit from developing the timber component in their agroforests.

The extensive surveys we have conducted in the Bungo district since 2001 indicate that many high value timber species do regenerate in rubber agroforest but that they usually make-up for a negligible fraction of rubber agroforest basal area. In 2003 these species were contributing a negligible share of the timber processed by saw mills in the area. The bulk of the timber processed was still being logged in the remnant forest patches.

Many farmers have started tending actively the high value timber trees spontaneously regenerating and some have even started transplanting seedlings from the forest.

In 2004 we conducted interviews in 5 villages and later organized an experimental sale of timber seedlings to assess farmers interest and potential problems. It appears that a large proportion of farmers are keen in experimenting more actively with timber planting. However, successful diversification of rubber agroforest production through the enhancement of the high value timber component faces a number of challenges:

Technical issues

· access to proper germplasm is currently limiting and would require some major effort; any technical development should aim for a large portfolio of local timber species in order to maintain the multispecies characteristics of rubber agroforest

which is a condition for their sustained conservation value,

· a switch from cyclical to permanent agroforest (which is also likely to increase the conservation value of rubber agroforest) will ensue from the incorporation of long lived timber species, that may not be acceptable to all farmers. In certain parts of the district, farmers already manage their rubber agroforest through gradual rejuvenation of the rubber tree population (some productive rubber plots are now ca. 80 years old), indicating that this is technically feasible.

Timing issues

· recent shifts on the international timber market indicate that demand for species which are currently logged in natural forest may not last if the supply is interrupted for too long a period. This calls for quick action and careful assessment of the market trends.

Policy issues

Some less pressing issues will need to be dealt with at some point including

· ensuring the right for farmers to commercialise the timber grown in their agroforests; this may become a hot issue if bans on certain forest species are enforced internationally to protect the natural forest (eco-labelling would then probably become inescapable)

· in some areas unclear land tenure rights are likely to act as a disincentive to invest in long term return timber and this will require additional efforts and coordination with local government.

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Dynamic of Insect Community Structure: Time, Space or Habitat Specific Patterns?

Dynamic of insect community structure related to time, space and habitat pattern in cacao plantations were studied between February and March 2003. The objective of this research was to analyze the effects of sampling period and spatial pattern on the structure of insect communities in general and their dynamic. Samplings were conducted at 16 sites belonging to two different habitat types (cacao agroforestry systems, natural forest sites) in Palolo valley at the easterm margin of Lore Lindu National Park (Central Sulawesi). The twelve sampled cacao agroforestry systems were situated in different distances to the forest margin (10 to 2200 m). The cacao plantations were located in the vicinity of the villages Berdikari, Sintuwu and Nopu. Two additional cacao agroforestry systems were situated inside the forest margin shaded by a cover of remaining natural forest trees. Two further sampled sites were selected inside the natural forest. Insects were sampled by treating single cacao tree crowns with a knock-down insecticide (Matador). At each study site five randomly selected trees were sampled. A total of 119,536 insect specimens were collected by spraying single cacao trees. Results showed that the most abundant orders were Hymenoptera, Collembolla, Homoptera, Diptera, and Coleoptera. Insect community structure was significantly affected by sampling period. Insect communities on cacao trees changed significantly with artificial disturbance by insecticide on cacao habitats. Increasing isolation of small blocks of cacao plantation from nearest forest did not have effects on insect communities, while a strong temporal effects was found. Samples within spraying periods proved to be more similar to each other than samples belonging to different spraying periods. Abundance patterns of one group of insects may affects another group of insects. Implications of these findings towards insects conservation are discussed.

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Land and Power: Agrarian Reform Strategies in Protected Forest Areas in Indonesia

Since 1998, a popular land claiming movement has been spreading over wide protected forest areas in Indonesia. As the movement escalated soon after the fall of President Suharto's centralistic regime (1998) and the subsequent promulgation of the national law on decentralization (1999), a strong causal relationship with the ongoing process of power decentralization can be assumed. In any case, the movement indicated a shift of power towards the actors at the local level, and this empowerment had different roots and sources of legitimacy: political, economic and socio-cultural.

We will portray three case studies from Central Sulawesi: Dongi-dongi, Sintuwu and Toro. All of them are involved in the process of land claiming inside the Lore Lindu National Park. Each community, however, represents a different empowerment strategy, thus standing for a particular type of locally induced agrarian reform. Dongi-dongi represents the "annexation type" which refers to a collective action by a group of villagers who claim and forcefully occupy an area within the protected forest against the regulations of public law. This case is a reform movement which is based on strong community support, or people power. Sintuwu, on the other hand, is a typical case of land reclamation inside the protected forest through "progressive cultivation", with a strong impact of cash crops (cacao). Though the Park Authority is still technically claiming sole responsibility and power of decision, the disputed land is de facto under control of local cash crop farmers representing the power of capital. Toro, at last, stands for the "integration type" which tries to build on a joint agreement between the local community and the Park Authority referring to a locally guided management of forest resources. This case represents a local agrarian reform which largely relies on socio-cultural power, expressed in communal decision making processes and in the reference to local knowledge.

There are significant data showing that the "annexation" and "progressive cultivation" type of agrarian reform have (at least temporary) ecologically destabilizing effects on the forest margin, the first in a more extreme way than the latter. From a socio-economic view, however, such encroachment strategies may be assessed as coping machanisms vis-à-vis an access gap to land resources, leading to more stability and security. There is a widespread expectation that one could prevent negative ecological effects and, at the same time, enhance socio-economic stability by promoting the "integration type" of agrarian reform. The Toro case offers some corresponding indications. On the other hand, however, it

also shows symptoms of alienation by the two other varieties. This could finally lead to the conclusion that concepts for sustainable forest management must re-evaluate the economic factor and the power associated with it. In other words: land reform movements and concomitant concepts of natural resources management which mainly rest on socio-cultural dynamics and recourse to local knowledge could conceal actual and powerful interests in the background. In general, the acknowledgement and steering of such forces may offer a key to the prevention of an extensive ecological destabilization of forest margin zones in the long term. In particular it could avert land claiming initiatives from developing into uncontrolled and ecologically disastrous annexation movements.

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Household Tree-Resource Use and Agroforestry Uptake: Evidences against Need Approach

Household need approach assumes that household needs for tree products would act as an incentive for growing trees on the farms. Further it is assumed that use of fuelwood substitutes like kerosene, liquid petroleum gas, cow dung cake would act as disincentive for agroforestry uptake. Present study provides empirical evidence on how tree-based needs would affect the level of agroforestry uptake (number of trees on the farm). The number of trees per farm was significantly higher in households with non-forest (ownland+purchase) sources of fuelwood; cattle dung, crop residue, charcoal, kerosene, LPG use as domestic fuels; non-forest (ownland+purchase) sources of timber. The number of trees per farm increased initially with increase in distance of the household from forest and then declined which could be attributed to the influence of the clayey loam soil. The number of trees per farm decreased with increase in fuelwood consumption, travel distances to collect fuelwood, weekly frequency of collection of fuelwood, brushwood consumption, total energy consumption, fuelwood dependency, timber consumption and availability of timber from T.D. rights. The study implies that it is not the need (as assumed under need based hypothesis) but the availability (physical or economical) affect agroforestry uptake. Therefore, planning agencies should not base agroforestry programmes merely on a need-based approach rather they should consider the physical or economic availability of tree products.

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Towards Increased Sustainability: Systematization of a Participatory On-Farm Experiment with Agroforestry Systems

Since 1993, the Centre for Alternative Technologies of Zona da Mata (CTA-ZM), an NGO that is based in the State of Minas Gerais, Brazil, has developed a participatory on-farm experiment in coffee agroforestry systems in cooperation with representative organizations of farmers' households and the Federal University of Viçosa (UFV). The experiment has been carried out in different municipalities close to the State Park "Serra do Brigadeiro". This park is a large forest fragment of the Coastal Atlantic Rain Forest Biome, which is considered one of the 25 "hot spots" of biodiversity worldwide. The region is hilly and characterized by higly weathered soils. The family agriculture is diverse, although the main source of income is coffee.

One of the difficulties encountered in scaling up agroforestry systems and other agroecological technologies that have been developed in the field by NGO's such as CTA-ZM is the lack of systematization. We therefore systematized the knowledge accumulated by the farmers, the data generated through scientific research and the experimental methodologies used by the institutions, using a participatory approach. Here, we present the developed participatory methodology of systematization, describe the on-farm experiment process, and present the information, the analyses and the main conclusions obtained.

The process of systematization took 18 months, and it served as a forum for reflection, analyses and collective construction of knowledge. We collected, organized and analyzed data mainly on: i) institutional intervention; ii) participation of the population involved; and iii) the impacts of the on-farm experiment. Within these topics, the main subjects studied were the management of the agroforestry systems, the interconnection of the agroforestry systems with the other systems of the farm, the environmental aspects, the partnerships, the methods used by the institutions to set the agroforestry experiment and the market for the agricultural products.

The adopted participatory method consisted of visits to the farms, as well as semi-structured interviews and meetings involving farmers, technicians from CTA-ZM, and staff and students of UFV. When appropriate, techniques adapted from Participatory Rural Appraisals were used to recollect and analyze the data of the participatory process. Among these techniques, we used maps, preference

analyses, historical matrices, and venn diagrams.

The process was dynamic, allowing characterization of different phases: a) awareness building for the experimental process; b) implementation of the agroforestry systems; c) external influence on the design and management of the systems; d) evaluation of the intervention; and e) redesign of the systems. In each of these phases, there were differences in institutional intervention, soil quality, quantity of trees utilized, manual labor, productivity and coffee quality. In each step, the participatory approach allowed farmers and technicians to learn from experience with the technology, and its adaptation to diverse conditions. Based on personal observation, preferences and local conditions, the farmers were able to decide upon the combination of species as well as the most suitable techniques to manage their system. As a consequence, systems varied with respect to choices made and management. Nevertheless, the main criterion used for the introduction into or elimination of tree species from the system was their compatibility with coffee, i.e. the lack of competition among introduced trees and coffee trees.

The systematization resulted in the construction of a methodology for participatory systematization, an in-depth analysis of methodological questions concerning participatory processes for family agriculture. Besides, it resulted in clarification of technical and methodological details concerning management and design of agroforestry systems, including the potentials and limitations of the species used. Using the indicators of sustainability, we conclude with respect to productivity, that agroforestry systems contributed to the diversification and the decreased of production costs. As regards to equitability, the entire community profited from environmental benefits such as reduction of pesticide use, better soil and water management. Initial negative results did not result in farmers renouncing, but resulted in farmers modifying their systems, and financial stability of the farmers increased due to diversification of the products produced showing stability/resilience. The system showed flexibility, allowing farmers modifying the design, the management and introduced tree species according to their necessity and knowledge. The process led to more autonomy of the farmers because they were less dependent on the coffee prices and the price of the inputs (they use less inputs), and they were free to introduce modification in the systems according to their wills. Finally, lessons from this process were extracted and organized and will be now be disseminated to a wider audience.

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Diversity Comparison of Non-Vascular Epihytes on Cacao Plantations with Different Shading Canopy Layers

Throughout the tropics, natural forests are transformed into agroforestry systems. Non-vascular epiphytes are valuable ecological indicators, reacting quickly to habitat changes and disturbances. To investigate impacts of different agroforestry practices on the structure of non-vascular epiphytic plant assemblages, bryophytes and lichens were studied on cacao trees in Central Sulawesi, Indonesia. We compared agroforestry systems representing three different levels of land-use intensity, namely cacao trees planted under natural forest canopy tress, under a mixed canopy of fruit trees, and under a monospecific canopy of shade trees (Erythrina, Glyrcidea). Four samples of 400 cm² each (one for each aspect) were taken at three different height levels (main stem up to first ramification, inner canopy, outer canopy) on 27 cacao trees, resulting in 324. Highest diversity and highest cover percentage of bryophytes were found in the inner canopy. Macrolichens had highest diversity pattern in the inner canopy, whereas cover was more equally distributed among the height zones. No preferences were observed relative to aspect. These general diversity patterns were found in all three plantation types. However, on plantations with various planted shade trees, the cacao trees showed the highest diversity of non-vascular epiphytes. Diversity declined by about 25% on cacao trees in plantations shaded by forest canopy trees, and by about 50% in plantations with monospecific shade trees. In contrast, cover percentages of macrolichens and bryophytes were similar in all plantation types. These results show that the composition of the non-vascular epiphyte communities on cacao trees is strongly influenced by the diversity and composition of the shade trees, either because different shade trees serve as sources for epiphyte species colonizing the cacao trees and/or because they influence microclimatic conditions.

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What is Community in Community Based Natural Resource Management?

This paper like to shed some light on the basic assumptions behind the concept of Community Based Natural Resource Management, which under lay many concepts of natural resource management intended to delegate different amount of rights to village communities in the use and management of the forest. This paper tries to assert that the mentioned basic assumptions have misconceived the nature of village communities living near and inside the forest as homogenous, in subsistent living communities. In many instances however incorporation and differentiation processes have fundamentally change the communities in almost all its aspects. This misconception as a matter of course will lead to miscommunication and misunderstanding between the stakeholders relevant to the establishment of the community based resource management.

To illustrate the above standpoint, the author invite the readers to look at the processes of establishing a Community Based Forest Conservation in a village community which has been experiencing profound changes in almost all field of life. A fate commonly shared by many communities living at the margin and inside the forest, but still received scanty attention. The community in this case is part of the upland village communities that shared administrative borders with the Lore Lindu National Park, in Central Sulawesi, Indonesia. Data's used in this paper were collected during several field studies in 2002 and 2003, as part of the A2 - STORMA research program under cooperation of the Tadulako University in Palu, the Bogor Agricultural University (IPB), the University of Gottingen and the University of Kassel.

The first part of the paper will take a look at the basic assumptions of the Community Based Natural Resource Management (CBNRM) concept, under which we can consider also concepts as Community Based Forest Management (CBFM), Community Based Forest Conservation, Social Forestry, etc. Especially important is the assumption on the village communities living near and inside the forest, which are perceived as social and culturally homogenous communities, still living on a subsistent level. Part of this assumption are the customary law's and local knowledge attached to these communities, which are assumed as in it self conservationist in character. In reality however, many if not the majority of these village communities were already experienced far going changes. For an important part through large-scale interventions by the colonial state and continued by the national state after the independence. Based on this misconception on the nature of the communities living near and inside the forest, community based management programs were launched and often failed.

The above stand point will be illustrated by data and information of a local village community which had – and still has – endured a tremendous changes since the beginning the 20th century. External agents by means of forces never encountered before have laid these changes upon the local communities. The changes include violent pacification by colonial forces, followed by forced resettlement and the suppression of local cultural expressions. These processes of subjugation were followed by more institutional and structural changes in the field of land tenure, land use, political organization and in the realm of religion. History had mobilized all the ingredients for a fast process of social differentiation. A process which became more complicated by the immigration of land hunger farmers and petty traders, who are ethnically and in terms of religion different from the local community.

The third part of the paper will dealt with the experience of the community in case in establishing a community based forest conservation program, initiated by the National Park Authority with the help of local and international NGO's. This part of the paper illustrates the problems confronted in the establishment of the program. Caused among others by the misconception of the nature of the local communities on the part of the National Park Authority but also by the different local as well as international NGO's that full-fill an important role in the implementation of the program.

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Differential Responses of three Weed Species to Light Intensity in Palolo Region, Margin of Lore Lindu National Park, Central Sulawesi

When different agricultural systems are developed in an area the accompanying weeds dominating the system also change. A series of surveys were carried out inWuasa, Alitupu, Watumaeta, Kaduaa, Dodolo, Wanga and Katu villages, in the margin of Lore Lindu National Park, in the sub district of North Lore Lindu, district of Poso, province of Central Sulawesi, on cropping systems, from upland rice under the slash and burnt methods, corn, and cocoa plantation. Simple cluster analysis showed 3 groups of weed communities, one was typical of secondary forest community with the vegetation was stilled dominated by T.tomentosa. The second group was Bidens pilosa, Ageratum conyzoides, Crassocephalum crepidioides, and Cupea balsamona, and the last group typical of weeds adapted to perennial crops mainly cacao, was dominated by Paspalum conjugatum. Three dominant weed species B. pilosa, P.conjugatuom and C.balsamona were studied under laboratory condition. They were subjected to shade treatments consisting of 2 levels, i.e. (1) full sun light, and (2) with 50% cover, made of blade of bamboo stem with 2 cm width and fixed at a space of 2 cm, in a cage of 3 x 4 m and 2 m height. These 2 light treatments were combined with 3 species and replicated 4x. Shading reduced leaf thickness 13.1%, 5.1%, and 7%, but increased leaf width 29.9%, 46.2% and 83.2% increase stomata number/leaf 22.61%, 15,91% and 10.98% for P.conjugatum, B.pilosa and C. balsamona respectively .Shading also reduced NAR (Net Assimilation Rate) being B.pilosa >C.balsamona>.P.Conjugatum. NAR of P.conjugatum was similar either in the sun or shaded 50%, Seed productions were also reduced i.e. 5,45%, 53.67%, and 22.29% for, P.conjugatum, B.pilosa and C. balsamona respectively. It was concluded that P.conjugatum was more adapted to shaded condition and B.pilosa was more adapted to condition under a direct sun light. C.balsamona although was able to adapt to so much climatological conditions but was not as good as P.conjugatum when under shade.

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National Law and Regional Administration in Indonesia: Does Regulation Benefit to the National Park Management under Decentralization? The Example of the National Park Lore Lindu in Central Sulawesi

Before the Regional Autonomy Act No. 22 Year 1999 into forced, National Parks were almost under a very centralistic management. Since the decentralization has been implied into all regions in Indonesia particularly in districts (Province or Kabupaten/Kota) enjoy a bigger freedom to implement own regulations applying for its territory.

The National Park Lore Lindu is located in the province of Central Sulawesi and stretch over two districts and more as a dozen sub-districts. Therefore in the border zone or margins local regulations applies, which should be conforming to national law. But are they?

Theoretically, national regulations providing a framework always are being referred in the making of regional regulations (PERDA) that imposed in regions. In another words that the regional legal regulations will filling in the national regulations. Does existing national law give a path to region making an operational PERDA?

But for different reasons PERDA often leads to more confusion than clarification, widen gaps instead of filling the National Law.

The problems will be deeper when the region repeats the provision in national into their legal regulations, instead of filling the gaps to make the regulation better effect for Province or Kab./Kota.

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A Balance of Ecological Economic Factor of Traditional "Pampa" Agroforestry at the Rainforest Margin in the Lore Lindu National Park Area, Central Sulawesi

Achieving a balance of ecological and economical factors is one of the main objective of sustainable resource management. This is a particular challenge at the rainforest margin where the forest resources are frequently under hight conversion pressure to more intensive, agricultural land use. The development and implementation of agroforestry systems is a promising approach to stabilise the rainforest margin while increasing the economic potential of local agriculture. If traditional agroforestry systems are present in an area, the systematic analysis and development of locally adapted agroforestry systems requires knowledge on the ecological and economic performance of traditional systems. In this paper, we provide backgraund information on the "Pampa" agroforestry systems traditionally practiced in the Lore Lindu National Park (LLNP) area, Central Sulawesi, Indonesia (Palolo Subdistrict, Donggala District). Specipically, we (1) describe the development of Pampa and some of its ecological key characteristics in relation to natural forest, (2) asses the economic value of Pampa, and finally (3) analyse the ecological compatibility of Pampa in relation to natural forest and Pampa economic value.

Ecological data was collected in a total of 25 subplots (20 m x 20 m) of Pampa stands at the forest margin and of 25 subplots (20 m x 20 m) of natural forest nearby in 2001. From these data, tree size class distribution curves were constructed for the natural stands as well as for the Pampa plots. Because forest stands structure as measured by tree size class distribution curves is a key ecological characteristic, we used this variable as an indicator to compare the ecological performance of Pampa plots with natural forest plots. The villages were selected using the Neymann Allocation Method with the ratio of village forest area and population as the stratification variable. Sintuwu, Tongoa, and Rahmat directly border LLNP forests. Berdikari, Bahagia, and Ampera are not. From each village, 30 households were selected randomly (Ntotal=180).

Pampa originated in abandoned shifting cultivation fields. After growth of secondary forest, undergrowth plants were cleared in order to plant different crops and other economically preferred plants between existing trees. This process results in a complex forest garden. The Ogawa method was used to differentiate the vertical stand structure of Pampa and natural forest. Although Pampa stands

have 7 strata and natural forest stands have 6 strata, but there was no significant difference between the stand structure of Pampa and the stand structure of natural forest according to statistical F-Test. Plant species richness and the number of individuals was lower in Pampa plots compared to natural forest stands. It imply positively into the ideal balance among individual number in each plant species or equality coefficient which was measured using Coefficient of Sorensen and Coefficient of Jaccard.

Total economic value of Pampa was about 166,000,000 IDR per hectare/year (€ 1 = Rp 12,200). Direct value was 24,000,000, IDR, indirect value of 141,000,000 IDR, option value 400,000 IDR and existence value 600,000 IDR. Regression analysis shows that length of stay in the village and use value of Pampa perceived by the respondent was positively correlated with the direct value of Pampa, while length of education was negatively correlated.

The ecological performance of Pampa was assessed in comparison with natural forest stands and related to Pampa direct value, i.e. an important aspect of economic performance. The stand structure of Pampa was compared with the stand structure of natural forest using the tree diameter class distribution (N of trees/size class/ha). At less than 10 cm DBH (Diameter at Breast Height), the diameter class distribution curves are not parallel, and the curves have the biggest distance. At this diameter class, Pampa appears rather incompatible with natural forest. On the other hand, this size class is dominated by commercial crops, such as cocoa and coffee, resulting in the highest economic value. At the tree diameter size class of more than 50 cm DBH, both curves were very close indicating high ecologivcal compatibility with natural forest. The economic value of Pampa for this size class is also high as this it is dominated by commercial tree species such as Elmerillia sp, Durio zibethinus and Lithocarpus spp. At the size class of 10-39 cm DBH and at 40-49 cm DBH, the curves tend to approach each other. Here, the economic values of Pampa trees were lower as the Pampa plots are dominated by non-commercial trees.

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Relative Importance of Bee Pollination to Coffee Production

The self-fertile highland coffee (Coffea arabica) is known to profit from pollination by bees. In many studies fruit set of this species was shown to be increase through pollination by bees in comparison to self pollination. However, increases in fruit set varied greatly between studies and investigations on the contribution of bees to coffee production differed in experimental methodology and coffee growing region.

We studied the respective contribution of different pollination types (cross pollination by bees, cross pollination by wind, and self pollination) to coffee production in 22 traditional coffee agroforestry systems in Ecuador. We evaluated fruit set monthly until harvest, including fruit abortion, fruit mass and size as indicator of fruit quality and observed the natural occurring bee community visiting coffee flowers. Additionally we took the habitat parameters light intensity, canopy cover, and plant diversity for possible relations with fruit set and abortion rates. Initial fruit set was significantly higher in open pollination than in self or wind pollination. During fruit development a significantly higher percentage of fruits was aborted in open (90%) and self (88%) pollination than in natural cross pollination (78%). This resulted in a significantly lower final fruit set of open pollination than natural cross pollination, with an intermediate final fruit set of self pollination. Fruit quality, expressed by fruit length and weight, was significantly lower in open pollinated fruits than in self or wind pollinated fruits. There was no relation between initial or final fruit set in open pollination and species richness or density of bees observed, nor to any of the habitat parameters.

Bees contributed to fruit set in coffee, as initial fruit set was highest in open pollination. But the high abortion rates found in our study lead to the assumption that this contribution may be limited by factors affecting fruit development, for example nutrient resources, climatic conditions, insect damage or pests. We underline the importance of evaluating fruit set of coffee from the beginning until harvest for drawing appropriate conclusions on the relative contribution of bees to coffee production. We conclude that the relevance of bees for the production in coffee has to be considered for each growing region separately taking into account regional specific biotic and abiotic conditions influencing fruit maturation and quality.

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FOCUS 3:

Ecological and socio-economic impacts of different forest-use intensities

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From Ecological to Political Buffer Zone: Ethnic Politics and Forest Encroachment in Upland Central Sulawesi

This paper discusses how ethnicity is used to define the internal "we" against the external "them" (Esman 1994), to grant preference, and to allocate socio-economic resources. Due to its conflict as well cooperation potentials, the diversity of ethnicity should be managed. When two ethnics are together in same area, one is defined as locals the other as newcomers, a competition over same resources occurs. Without proper management, without political actions, conflicts may take place.

Such propositions will be elaborated by analyzing two cases of forest-margin villages in the eastern side of Lore Lindu National Park (LLNP), Indonesia, i.e. Sintuwu at Palolo valley and Watumaeta at Napu valley. In both villages, the heavy influx of migrants has alter the proportion of locals to migrants. The "we" are the pioneer settlers (the Kaili in Sintuwu, the Napu in Watumaeta). The "them" are the migrants, with the Bugis as its largest ethnic migrants – over one-third households in 2001 are Bugis. In addition, house-clustering by ethnicity is common in both villages, an indication of social distance among ethnic groups (Charras 1993), which can be interpreted as proof of inability to adapt and unwillingness to integrate into or respects the locals (Human Rights Watch 1998).

In an attempt to rebalance local-migrant proportion, the "we" is extended to the later-come migrants perceived as related by same history, ie., the Kulawi in Sintuwu and the Poso refugees in Watumaeta. Adding the Poso into the "we" has, indeed, tipped off the balance in favour of the "we" population.

With most agriculture land inside the village transferred to Bugis migrants, the "we" change from landlords into landless, while the "them" from landless into landlords. Social destabilization occurred as ethnic frictions appear because of that. In a land-based economy, land scarcity means declining base of socio-economic security. To gain back their position and security, encroachment into the national park forest is adopted as a strategy by the "we" population, though with uneven access. This action was justified by disputing park borderline. At village level the illegal actions is formalized by giving to encroachers usufruct rights in the form of SKPL ("Surat Keterangan Pengolahan Lahan" or Letter of Land Utilization) issued by village head, and KKM ("Kesepakatan Konservasi Masyarakat" or Community Conservation Agreement) as was made in Watumaeta in 2004 by Village Council and LLNP administrators. Meanwhile, the "them" migrants use different strategies to obtain new agriculture land. The law-deference Bugis opt to open secondary forest in non-LLNP area of neighboring villages, or

to purchase land with a secure ownership. 'Secure', however, is an ambiguous word, since they would be willing to buy the 'legalized' land within the national park.

In this sense, encroaching forest is the "we" attempt of land expansion in a land-based economy. It is an attempt to re-stabilize relationship between "we" and "them" in the face of ethnic conflict, although at the expense of destabilizing forest margin. It is a local innovation in ethnic politics, in the absence of ethnic politics at national level, to neutralize destabilization of inter-ethnic relation. Such innovation, however, cannot go on endlessly, for once formalized, the "we"-opened new economic space there is a great probability of taken over by the "them". Hence restart the process of forest destabilization. The implication of this is the need to do a modeling that brought into account encroachment not only as an economic action, but as a political one as well.

Keywords: ethnic politics, ethnic relation, forest encroachment, Central Sulawesi

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Struggle over Access, Use and Control of Dongi-Dongi's Forest Resources: A Political Ecology Perspective

Dongi-dongi is one of the areas located in the core zone of the Lore Lindu National Park (LLNP), on the slopes of Mount Nokilalaki, in Palolo Subdistrict, Donggala Regency, Central Sulawesi Province. Since June 19, 2001, the ecological landscape of Dongi-dongi changes when residents of Kamarora A, Kamarora B, Kadidia and Rahmat villages in Donggala District, Central Sulawesi Province, occupied the Dongi-dongi forest area. Struggle over access, use and control of Dongi-dongi forest between farmers, government, local and international NGOs, and customary community began. Within the next 18 months the villagers dramatically changed the landscape and biodiversity of the core zone of Lore Lindu National Park: around 1,030 households occupied Dongi-dongi area and convert 3,400 ha of forest to dry land farming, illegal logging increase rapidly, one Dongi-dongi settler died as victim of illegal logging, and massive flood swept to down stream as thousands of cubic meters of soil slid down from the steep mountainsides of the Dongi-Dongi area. The farmers still remain in Dongi-dongi.

Our research shows that, first, the competition over access to land and trees and over the control of that access is not simply a diametrical conflict between the state and the peasantry. The involvement of local and international NGOs, along with their ideological narratives, advocacies, and political support, plus the fact that security officers are engaged in the illegal logging business, make the claims and counter-claims, threats and counter-threats, and struggles over Dongi-Dongi's resource not fully diametrical. Dongi-Dongi affair is the result of complex inter-woven causal relations of actors operating within a context of unequal power relations and cross-border problems. Second, Dongi-dongi affair is not simply a reflection of political and market failures, but rather a manifestation of broader political and economic forces particularly related to forest and conservation policy. Conservation policy failures and the government's weak commitment to solving agrarian problems, as well as the political interests of the local and international NGOs, were among the political factors outside of the village community that triggered the Dongi-Dongi occupation. Third, the Dongi-dongi affair is also the result of struggle over the discursive meaning of biodiversity conservation, which is deeply rooted in scientific knowledge and power that are politically constructed and inscribed on the imaginations and material lives of the objects of development. In summarize, all the actors involved in Dongi-Dongi – either the central government, the local government, the local and international based NGOs, community organizations, customary communities, and economic institutions related to illegal logging - directly or indirectly, with varying degrees of

involvement contributed to the Dongi-Dongi affair.

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Soil Microbial Population and Activity at Different Landuse Types

Microbes as a decomposers are a key factor in nutrients cycling in eosystems. The main sources of energy for mircobial life in soil is organic matter. The quantity and the quality of the organic matter in a certain ecosystem determine population and activity of soil microbes. The aim of this experiment was to determine the population and microbial activity at five land use types i.e.: Natural forest (A), Natural forest with minor timber extraction (B), Natural forest with major timber extraction (C), Agroforestry system (dominated by cacao) with remaining natural forest shade trees (D), and Agroforestry system (dominanted by cacao) shaded by a diverse spectrum of planted trees (E).

The parameters tested were (1) total number of propagules, (2) total number of fungi and (3) soil respiration. Total number of microbial propagules and number of fungi were determined by plate count method and soil respiration was determined by using the jar method.

It was observed that the microbial population varied considerably between ecosystems and within land use types. However, on the average, the microbial population in B and D was higher than in A, C and E. The total number of propagules in B and D were 388 108 cfu g-1 and 362 108 cfu g-1, respectively. The total number of propagules in A, C and E were 18 108, 52 108, and 129 108 cfu g-1, respectively. The results of the total number of microbial propagules was reflected in the soil microbial respiration except in land use type A. The soil microbial respiration in B and D (7.2 and 7.3 mg CO2-C kg-1, respectively) were higher than while in C and E (6.9 and 6.4 mg CO2-C kg-1, respectively). Interestingly, in land use type A (natural forest), although the soil microbial population was rather low (18 108 cfu g-1) but the soil microbial respiration was high (7.1 mg CO2-C kg-1). The population of beneficial microbes such as nitrogen fixing bacteria and phosphate solubilizing microbes will also be presented.

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Diversity and Abundance of Epiphytic Bryophytes on Trunk Bases in Relation to Use Intensity of Natural Forest in Lore Lindu National Park Central Sulawesi (Indonesia)

Forest use practices may change vegetation structure and environmental conditions, which in turn may influence the bryophyte communities. The impact of low and medium intensity forest use practices, such as rattan extraction and selective logging, on the epiphytic bryophyte diversity and abundance on trunk bases in submontane forest, were studied in the framework of the STORMA project in Central Sulawesi. Species diversity was scored by presence-absence within twelve 50 x 50 m² plots, including four in natural forest with traditional use only (land use type A), four in natural forest with rattan extraction (land use type B), and four in selectively logged natural forest (land use type C). Total abundance of epiphytic bryophytes on trunk bases was estimated as percent cover in 30 x 20 cm² quadrates. At least 40 species of mosses and 37 species of liverworts (33 leafy liverworts, 4 thalloid ones) were recorded. Most species occurred in all three land use types, few were found in one or two types only. The majority of the species were present with less than 10% coverage. A few mosses, including Pyrrobryum spiniforme and Leucobryum spp., and one leafy liverwort (Spruceantus polymorphus) covered more than 50% of total plot surface.

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Forest Structure as Influenced by Different Types of Community Forestry in a Lower Montane Rainforest of Central Sulawesi

In a lower montane rainforest (800-1140 m) of Central Sulawesi (Indonesia) we assessed the structure of twelve forest stands (0.15 ha each) which are subject to different types of community forestry. The sites were chosen in a small valley surrounding a village whose inhabitants utilize the forest in a traditional way. Forest use practices range from rattan extraction in natural forest to cacao agroforestry systems with a sparse cover of emergent shade trees remaining from the natural forest. The forest use differences reflect variable distances between forest stands and human settlements. The agroforestry sites, were commonly situated in close proximity to intensively used rice fields, whereas sites of mere rattan extraction were encountered at considerable distance to any settlements. Study aim was to relate stand structural properties to forest use types. Altered forest structure most likely will affect the cycling of water and nutrients in the ecosystem and will influence carbon sequestration and turnover in the soil.

Measured stand structural data included stand height, stem diameter (dbh) distribution, canopy size, basal area, and stem density. Basal area (trees dbh > 10 cm) ranged from high values in the natural forests (52.5 m² per ha) to 20.6 m² per ha in the agroforestry. Stem density peaked where large timber had been extracted leaving considerable gaps in the canopy (5495 stems per ha; out of which 695 stems > 10 cm dbh) and was lowest in cacao plantations (1706 stems per ha; and 254 stems per ha > 10 cm dbh). In addition, information on leaf area index (LAI) and canopy openness was derived from more than 30 hemispheric photographs from randomized locations on each site. Canopy openness changed greatly as a function of forest use intensity. Implications for forest functioning will be discussed.

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Afforestation Alternatives for the Tropics

On a global scale, the original forest cover was about 6 billion hectares before the human impact. According to the newest inventory of the FAO in 2000, the current area is 3.869 billion ha. 95% of this area are natural forests, 5% are forest plantations. 47% of the global forests are tropical forests, 9% belong to the subtropical zone, 11% are temperate and 33% boreal forests. In the second half of the 20th century, from 1960 to 1990, about 450 million hectares of tropical forests disappeared. The maximum deforestation rate has been registered in the 1980s, when the annual losses reached up to 20 million hectares. In the 1990s, the world wide loss of forests, mainly in the tropics and subtropics, amounts to 14,6 million hectares every year, the compensating plantations only 5.2 million hectares, mainly in the temperate and boreal zones. Hence there is a global forest net loss of 9,4 million hectares per year.

The global demand of wood, however, is increasing by 1.7% per year (FRA 2000). More and more environmental arguments are of particular relevance for afforestation activities: to prevent soil erosion and reduce flooding, to stabilize slopes, to act as windbreak, to prevent desertification and to improve the global problem of climate change by carbon sequestration. In terms of biodiversity, afforestation is often regarded controversial: Particularly in the tropics and subtropics, the new plantations are often monocultures of mostly introduced tree species. Only the two genera Pinus and Eucalypt constitute almost one third of the trees for new plantations.

In the south of Costa Rica an afforestation project has been installed where indigenous tree species and introduced, so-called "fast growing tree species" have been planted under different climate and soil conditions. In four growth regions with a great site variation (altitude: 5 – 1100 m asl.; annual rainfall 2000-4000 m; average annual temperature 20-27 °C) six different tree species with a total number of 4700 individuals have been planted. After 7 years it could be shown, that the general growth dominance of the introduced species is not valid for all sites. Particularly in hot and extreme wet lowlands, the growth potential of the introduced tree species (i.e. Gmelina arborea) is not much higher than the growth of high performance indigenous species (i.e. Terminalia amazonica, Vochysia sp., Hieronyma alchorneoides). This result offers opportunities for ecological and efficient afforestation concepts in the future.

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Forest Conversion and Rural Migration – Investigating Local Variations

The degree of forest degradation and conversion of Lore Lindu National Park in Central Sulawesi, Indonesia, and the bordering community forests varies considerably even within relatively small distances. The commercial extraction of timber and rattan and the permanent conversion of forest into privately owned arable land is much higher close to villages that experienced rapid and high population growth. However, the simple formula "rural immigration equals deforestation" obstructs the view on the more complex multi-causal relationships underlying deforestation.

Based on the analysis of semi-structured interviews with selected households in several villages in four districts we emphasize the necessity to examine the reasons why migrants move to certain villages but not to others.

Generally speaking, the affluent migrants from other provinces are attracted by the relative ease to purchase fertile land in certain villages. In these particular villages the community forest has nearly vanished completely. Plots are cleared by locals first in order to establish ownership rights and then sold to the migrants.

While the latter have the means and knowledge to invest into labour extensive cacao cultivation, which is rapidly becoming the dominating cultivation system in the region due to strong incentives of favourable world market conditions, the former face more difficulties to seize the benefits of the cultivation of perennial crops.

The national park authority is not capable of controlling illegal logging. It is important to note that it is not the migrants who initially establish plots inside the national park. Instead, locals open these fields and then may sell them to the migrants. Often the village leaders are involved in these land transactions, conveying the impression to the migrants that these are legal arrangements.

In contrast, in other villages the leadership adopts a supportive attitude with the regard to the national park and aims at preserving the community forest. With restriction to the conversion of the forest resource they put a constraint on the amount of land available to migrants, making their village less attractive for newcomers.

With mounting market and population pressures on forest resources and lack of enforcement by the central state, local governments and institutions have a strong influence on to which extent migration leads to forest conversion in their village.

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Amphibian Communities on the Cutting Edge – Assessing the Impacts of Anthropogenic Disturbance on Multi-Species Systems in Tropical Forests

Timber harvesting is currently the most common utilisation of tropical forests. Assessing the effects of logging activities on biodiversity and general ecosystem functions is thus of primary importance to conservation. The results of our studies on amphibian communities in two globally important eco-regions (Upper Guinea, West Africa and the Guiana Shield, South America) suggest that the predictability of species assemblages largely depends on the respective level of anthropogenic disturbance imposed on a particular habitat. Hence, human activities that lead to changes in the structure of a habitat, such as logging, not only alter the composition of organisms that form a particular assemblage but rather alter the dynamics of the entire system. We were able to detect a transition from generally stochastic systems in undisturbed primary forests to deterministic systems in highly altered secondary forests. Potential effects on the system's dynamics are poorly understood or have only inadequately been addressed in previous studies. Yet, this knowledge is crucial for the understanding of biological systems in general and systems that are strongly altered by human activities in particular.

Models that implement results of population studies focusing on the susceptibility of particular species to alterations in their environment, as well as community level analyses focusing on entire assemblages, shed light on the processes leading to the observed patterns. Our analyses of two different multi-species systems indicate that the actual mechanism leading to the observed change of predictability patterns and transitions from stochastic to deterministic systems, largely depends on functional differences between species and/or differences in the number of species within a functional group, rather than number of species per se. It remains difficult to completely separate the effects of species and functional group richness in statistical analyses. Their particular contribution to changes in predictability patterns of biological systems is yet to be tested systematically.

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Anthropogenic Risk Factors and Management of Biodiversity for Rural Livelihood around Rainforests in East Africa

Introduction into general setting and topic of research programme:

BIOTA EAst Africa links a set of thematically coordinated analyses of biodiversity changes in East African highland rainforests, especially Kakamega Forest in Kenya.

Specific research project:

How to conserve and protect biodiversity in a sustainable way together with the people living around the forest. Institutional analysis of strategies, policies and framework conditions for enhancing biodiversity through buffer zone management and participatory land use planning. Developing a method for participatory land use planning involving local stakeholders (farmers, administration, politicians, NGOs, others) in Kakamega District. Adaptation to other similar areas possible.

Partners in the research:

University of Dortmund (land use planning aspect), University of Bonn (agricultural production factors), University of Leipzig (small scale industires and economic aspects), diverse Kenyan partners from universities, NGOs and administration. Bundesministerium für Forschung und Technik

Time frame of the research:

June 2004 to May 2007 (with probabiltiy of estension to 2010)

Further contents: more details about hte research; photographs and maps from the area

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Plants Medicinales: Liana Combretum Mucronatum

The reserve of biosphere of Cameroun is localized between 2°50 and 3°40 northern latitude on the one hand, and 12°20 and 13°40 longitude on the other hand. It has a surface of 526,000 ha. Populations there continue to have recourse to traditional medicine and medicinal plants for current problems of health.

According to ethnobotanic investigations led in the whole of the reserve and its periphery, more than 3,500 therapeutic indications were collected near the popular pharmacopeia and the specialized pharmacopeia. Those utilize 350 vegetable species in the treatment of 77 diseases or symptoms. Data treated within the framework of this study relates only those indications relating to intestinal helminthiases, a group of diseases whose rate of parasitologic prevalence is very high in rural medium.

Among the plants indicated, like anthelminthic, the liana combretum mucronatum is the species most used in traditional medicine. It represents 107 indications in specialized pharmacopeia. Whatever the ethnos group considered, combretum mucronatum is indicated locally by a vernacular name which means "the cord of the worms."

Combretum is variously employed among Pygmies. Crushing of the plant constitutes the dosage forms most employed, always managed orally. Whether using sap or bark for the preparation of the medicine, the villagers completely cut the stem with a machete, taking away its regeneration properties.

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Space Occupation Countumiere of Forest Space

The reserve of biosphere of Cameroon and its surroundings are inhabited according to a linear model, primarily along the tracks. The populations which live there are of Bantous and Pygmies organized in six ethnos groups: ZIME, BADJOUE, BULU, FANG, KAKA, and BAKA. They practice hunting, fishing, gathering, collecting, and a traditional itinerant agriculture of subsistence. Since 1995, Cameroon has planned the zoning of its southern most forestland with the goal of defining which surfaces are assigned to the permanent forest field and which surfaces deal with the nonpermanent forest field.

Within the framework of drafting the plan of installation of the reserve, the question of how much surface to grant to each village (zones of village exploitation) arises. The forest belt under the villages is uninhabited, not being the subject of usual appropriation. The space occupation leads to a set of specific problems: fertility of the grounds, knowledge of the medium by the populations, common law, and control halieutics. Space then becomes, at the same time, a factor of integration and specification.

The landscape which results from agriculture in the inhabited parts of the reserve of fauna of Cameroon, are small island anthropogenes in a matrix of vegetation little influenced by man. This mosaic can contain a biomass raised in small and average mammals, even with a strong pressure of hunting. The primary presence of forest has its importance in the mosaic, because it brings a rich food suitable for increased reproductive success. The agricultural soil proves to be an agro-ecosystem with a relatively high ability to put up with increasingly high pressures.

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An Application of the Ecosystem Services Approach to the Valuation of Biological Diversity in Central Sulawesi (Indonesia)

1. Introduction

The Central Sulawesi rainforests are part of the global Wallacea biodiversity hotspot. Because of their exceptional contribution to global biological diversity, the conservation of the Central Sulawesi rainforests is an important case for an application of conservation strategies in line with the CBD Ecosystem Approach and its requirement to account for the economic context of conservation. Thus, it is our main objective to generate knowledge that facilitates the design of economically informed conservation strategies. In this paper, we report on the first results of locally perceived values of biodiversity in Central Sulawesi using a choice experiment approach.

2. Methodology

The choice experiment study was carried out in districts around the Lore Lindu National Park (301 face-to-face interviews in randomly selected households in 15 villages). The choice experiment covered 5 attributes of an environmental good defined as a government development program. The attributes relate to different categories of the Total Economic Value approach. Each of the attributes takes several values (levels) that allow for a systematic variation in the composition of the good. The levels of the cost attribute represent the "price" the respondent is willing to pay for the implementation of the specific instance of the good (scenario). Via choosing one from two systematically designed scenarios (and a status-quo-scenario), respondents express their economic preferences. The attributes are

• populations of different sizes of the endemic dwarf buffalo anoa (Bubalus depressicornis);

existence value ; species level;

• availability of rattan (Calamus spp.) as expressed in distance from village; direct use value;

species level;

• preponderance of cocoa plantations differing along a shade tree gradient; indirect use value;

functional/ecosystem level;

• availability of irrigation water for wet rice cultivation as expressed in number of

months with

water scarcity; indirect use value; functional/ecosystem level.

The cost attribute was split-sampled as a rise in tax or a donation to a village fund as well as a monthly or yearly payment scheme. We used a main-effects orthogonal design. Because of the high variability in environmental and social conditions, the status quo option was adjusted to the local situations and to individual perceptions. A dominant choice set was included to test for rationality. With the exception of the anoa attribute, we use an ecosystem services approach to translate biodiversity and ecosystem structures and processes into concepts relevant to the respondents. We report economic preferences as calculated by LIMDEP's multi-nominal logit procedure (MNL). Linear utility functions were assumed. Marginal WTP values were calculated as absolute value of the ratio of the MNL-attribute coefficient and the coefficient of the payment attribute.

We expect a negative sign for water and rattan, indicating disutility associated with an objective impairment of the respective levels, and a positive sign for anoa. For cocoa, no a priori expectation was made.

We further hypothesize that anoa protection is a luxury good; rattan and water availability are necessities. The respective hypothesis will be tested using extensive socio-economic data on the economic situation of the respondents (STORMA sub-project A4).

3. Results

Most respondents understood the choice experiment sufficiently - and were sufficiently attentive - to detect the clearly dominant choice (95%). All coefficients of the attributes were significant ($p<0,01$ or lower) and showed the expected sign. Cocoa was negative and significant. Calculated WTP range from 35 (anoa, 1 individual more) to 33581 (water, one month less with water scarcity) IDR/year for a marginal unit of the attributes.

4. Summary

With a carefully adjusted instrument, the choice experiment could be conducted successfully in an ecologically and socially diverse rural area in one of Indonesia's Outer Islands. We claim that the design strategies to adjust the status-quo scenario to the individual respondents, and the translation of biodiversity values into ecosystem services contributed essentially to this result. Even though many respondents report lacking sufficient food at least once a month, we documented a positive WTP for an improved provision of ecosystem services which can contribute to biodiversity conservation objectives(water, rattan). Even for maintaining viable population sizes of the local endemic dwarf buffalo with minimal direct use value, residents have economic preferences. This indicates a willingness to contribute actively to the maintenance of their resource base amongst the inhabitants of the region around the Lore Lindu National Park. In

the fast growing sector of cocoa agroforestry systems, however, biodiversity conservation measures aiming at more sustainable ways of cocoa cultivation and against further intensification - expressed by a shade tree gradient in this study - would require external input.

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Ecological Impacts of Different Coffee Production Systems on the Montane Rainforests of Ethiopia

Ethiopia is the center of origin and diversification for coffee (Coffea arabica). The wild populations of can still be found in the rainforests. Being the center of origin, a wide range of coffee production systems exist in Ethiopia. These include: forest-, semi-forest-, semi-forest plantation-, garden- and plantation- coffee production systems. These production systems represent different intensities of forest management and levels of domestication of coffee. This paper presents the descriptions of the different production systems and compares the impacts of the different management intensities on plant species diversity, vegetation structure and the coffee population. The forest coffee production system is a system with little intervention or management intensity, and is the most diverse and structurally complex system. It represents the about 9% of the forest area used for coffee production in the country. The semi-forest- and semi-forest plantation-coffee systems are also forest based systems with moderate management intensities. Species diversity and vegetation structure have changed significantly in these systems, as compared to the forest coffee system. The semi-forest systems are, however, much more diverse, and structurally complex than the garden and plantation coffee systems. Ecological impacts along gradient of management intensities and implications for conservation are discussed in detail.

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Patterns of Fine Root Mass and Distribution along a Disturbance Gradient in a Montane Tropical Forest, Central Sulawesi

The effect of increasing forest disturbance on fine root systems has been studied in the margin zone of the Lore Lindu National Park, Central Sulawesi. Study objectives were to analyse effects of increasing canopy gaps, which result from forest disturbance, on tree root system size and dynamics and related carbon storage and turnover. Stand totals of fine root biomass (0-50 cm), vertical root distribution patterns and fine root biomass/necromass ratios were measured in four stages of forest conversion (ranging from natural forest with very low impact to intensively managed agroforestry systems with cocoa). These stages represent widely distributed forest use systems in the region. In addition fine root production estimates have been made by sequential soil coring with minimum-maximum calculation and by using the ingrowth core method.

Fine root density showed a similar exponential decrease with soil depth in all profiles regardless of the stage of forest conversion. Thus, canopy gap fraction seems to have only a minor effect on root distribution patterns. However, stand fine root biomass showed a decline along this disturbance gradient from approximately 400 g m-2 to about 200 g m-2. Thus, carbon storage in the tree root system is negatively affected by changes in canopy density and structure. We conclude that management and partial conversion of tropical forests has profound effects on the root system and thereby influences the carbon budget of the ecosystem.

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Using Landsat Images to Predict the Area of Desiccated Mesopotamian Marshlands

The Mesopotamian marshlands constitute the largest wetland ecosystem in the Middle East. They play a key role in the international flyway of the migratory birds, support endangered species and sustain fresh water fisheries. In addition to these important ecological benefits, these marshlands represent a unique element of Iraqi heritage and resources. The marshlands once covered 20000 sq. km including mainly Hammar, Huwaiza, and Qurna marshes of the interconnected lakes. However, in the past 30 years over 90% of the marshlands have been desiccated through the combined actions of upstream dams construction in Syria, Turkey, Iran and Iraq.

In this research a computer program was implemented to use a remotely sensed images in 1973 and 2000 respectively to calculate the area of the desiccated marshland of the Mesopotamia. The program was implemented in Visual Basic programming language. Although it is implemented for the above specific aim, it can be applied to many other applications through its ability to many image processing methods like smoothing, sharpening, solarizing … etc.

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Spatial Variability of Forest Soil Hydraulic Properties and Soil Water Flow

Soil hydraulic properties are important for water flow-related studies. They are fundamental to studies involving water balances, irrigation, movement of pollutants, and more generally, transport processes occurring in surface soils.

Soils are spatially variable natural bodies. Variation of parent material and vegetation across the landscape from which soils are derived affect the variability of soils even at relatively short distances. Because of this spatial variability, the hydraulic properties of field-scale soil unit also exhibit spatial variation influencing mass transport through the subsurface zone. Hence it is necessary to characterized soil hydraulic properties of the study area considering their variability.

Hydraulic properties represented by the soil water-retention curves (□ -□) and soil hydraulic conductivity function (K-□) were measured in the field using instantaneous profile method. Single ring infiltro-meter with dimension of 70 cm long and 30 cm in diameter, a TDR and five tensiometers were installed. The measured data was used to evaluate the Functional Models of Van Genuchten (1980) and Kosugi (1996), and both measured and model parameters were used to evaluate the spatial variability of hydraulic properties.

Using more than one parameters of hydraulic properties to describe the spatial variability is complicated. Simplification to get a single factor of the hydraulic properties is needed. Scaling theory introduced by Miller and Miller (1956) was modified and used to get a conversion factor called scaling factor to describe the spatial variability of hydraulic properties.

Measured hydraulic properties and model parameters of hydraulic properties of forested hill slope show large spatial variations. This is suggested due to the forest soil contain abundant macro pores as a result of faunal activity and high root density. Comparing scaling factor of studied forest soil and many crops soils, the forest soil exhibit a large variability of soil hydraulic properties compare to many crop soils.

Simulation the effect of spatial variability on hydrograph shows that the peak of hydrograph was lower when the mean value of hydraulic properties was applied than the peak of hydrograph when the variability was considered. Larger variation in the downer slope part cause the peak was higher and vice versa.

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Impacts of Different Forest-Use Intensities on Structure and Dynamics of Tropical Rain Forests

Understanding the dynamics of disturbed tropical rain forest is an important issue for conservation and sustainable management of these forests. In this paper we analyse the impacts of different logging activities on the structure and dynamics of tropical rain forests using the process and individual-based rain forest models FORMIX3 and FORMIND.

The models describe growth, mortality, recruitment of trees and competition between trees. The calculation of tree growth is based on a carbon balance. The carbon gain of a tree depends on the photo production of its leaves, respiration and other losses. Trees compete for light and space. Dying large trees fall down and create gaps in the forest. Tree species are grouped in plant functional types.

Applications of the models to tropical forests in Malaysia and Mexico are presented. Various logging scenarios were analysed assuming different logging cycles, logging methods, cutting limits and logging intensities. We characterise the impacts using criteria like yield, canopy opening and changes in biodiversity of trees. Multicriteria decision analysis was used to evaluate the scenarios. We analyse the trade-off between yield and achieving a desired ecological state of logged forest. The ecological state of the logged forests can only be improved by enlarging the logging cycles and reducing yields. Our study also demonstrates that high cutting limits or low logging intensities cannot compensate for the high damage caused by conventional logging activities.

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Classification of Hyrcanian's Rainforest Homegardens in Iran

The Iranian part of the Hyrcanian forests covers approximately 50.000 km2 and is located in the south of Caspian Sea. Fieldwork was conducted to investigate homegardens concerning agroecologic and socioeconomic variables. Altogether eighty homegardens were visited randomly. Complete data on socioeconomic variables and agroecologic factors was collected through direct observation and interviews. Data analyses showed different types of homegardens (e.g., vegetable, fruit and mixed homegardens). Cluster analyses were run utilizing both socioeconomic and agroecologic variables, but maintaining the number of groups from the a priori field classification in order to contrast farmer's perceptions, based on the function of their homegardens, with statistical classifications. They were done using Ward's minimum variance method to identify homegarden types, with squared Euclidean distances used as a measure of dissimilarity. In this study, the most compatible statistical classification, which matched field-based functional classification in 81.3% of the cases, was used. This was obtained using the following variables, which were standardized to zero mean and variance one: 1) total area 2) total number of zones 3) total number of uses 4) total number of species 5) fruit trees area 6) vegetables area 7) pulses area 8) percentage of total income from homegarden. The contribution of these variables to the formation of clusters was ascertained through a stepwise, variable discriminant analysis. Between groups comparisons for each variable were evaluated with a one-way analysis of variance. Using cluster analysis six types of homegardens were identified.

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Legal Bahavior of Local Communities Towards the Forest Margin in the Lore Lindu National Park Central Sulawesi Indonesia

Legal behavior of local communities towards the forest margin in the Lore Lindu National Park Donggala Central Sulawesi Indonesia

Lanini A., and Supriadi

The first purpose of this research is to identify the factors which influence the legal behavior of the forest margin communities in Donggala Central Sulawesi Indonesia. Second, to comprehend the pattern of forest protection in the local communities. Finally, the research is also aimed to find out legal principles of customary law. The method employed will be a mix of socio-juridical and anthropological approaches.

In the principle, access to natural resources was free, but required legal procedures via the Lembaga Adat in order to secure the natural environment. Despite the existence of local legal patterns, local communities still brake the law (encroach into the National Park).

Customary law as a legal institution is obeyed, since it is a part of the communities norms and beliefs. Traditional norm are still respected and appreciated, which foster the creation of institution of laws and sanctions with binding duties and obligations. Some customs which have been considered as an institution should be respected, such as palia and ombo that are related to natural resource protection and nogane or mpenoa as a ritual in taking a difficult decision in natural resource management or social affairs.

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Impacts of Land Use Practices on Wildlife in Cyclops Nature Reserve, Northern Papua, Indonesia

Traditional land use practices that entail slash-and-burn forest clearance by forest farmers have become one of the main causes of deforestation in the Papua region. This land use pattern mostly occurrs in available lowland forest including within protected areas and is driven by growing population pressures and accelerating development. In Cyclops Nature Reserve the slash-and-burn of forest is not only threatening lowland forest but also hill forest, since certain highland immigrants are used to clearing hill areas. Rapid deforestation may lead to habitat loss which adversely affects species diversity and population density of wildlife. Studies on butterflies and small marsupials in different land use types (agroforestry land, secondary forest and natural forest) in the southern part of Cyclops Nature Reserve revealed the differences in species diversity and population densities of wildlife among these habitat types. These studies were conducted in three different periods (2001, 2003 and 2005). About 87 butterfly species in three genera (Papilionidae, Pieridae and Nymphalidae) were found in natural forest; while 56 and 40 species of the same genera were recorded from secondary forest and agroforestry land, respectively. In particular, the highest diversity of Papilionidae was found in natural forest (Shannon Index, 0.82), followed by that in secondary forest (0.75) and agroforestry land (0.13). These results suggest that species diversity of wildlife are negatively affected by human intervention. After a standard trapping period (5 x 5 traps) run for five nights, it was found that the relative abundance of the spiny bandicoot (Echymipera kalubu) was lower in natural forest (Capture Index, 0.032) than in secondary forest (0.096) or agroforestry land (1.104). The possible reason is that the range of its habitat is restricted to natural forest. These findings might be important since forest margins comprise a significant proportion of the protected areas in Northern Papua. They may also play an important role in the future Reserve zoning concepts as well as in conservation-oriented land use management.

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The Predominant Role of Biodiversity Conservation in the Regional Development and the Maintenance of the Ecosystem Equilibrium - The case of Zahamena-Mantadia Forest Corridor, Madagascar

The new strategy to conserve 9 millions hectares of natural forests in Madagascar consists in "tripling the size of protected areas from 1.7 million hectares to 6 million hectares over the next five years" according to the Madagascar President's announcement at the World Parks Congress in Durban in 2003. Madagascar is one of the top five global conservation priorities. Primate biodiversity and endemism are both very high, making it among the world's highest priorities for primate conservation. The island also contains between 10,000-12,000 plant species, of which more than 80 percent are endemic. But Madagascar's impressive biodiversity is highly threatened. It has been estimated that between 150,000 and 200,000 hectares of forest disappear annually. At this rate, all of Madagascar's forests, apart from a few isolated patches, will disappear within 40 –60 years.

This conservation strategy adopted by the government is implemented through the creation of a new category of protected areas called "Conservation Sites" with multiple forest-uses co-managed by local communities, public services, civil societies and private businesses. This strategic Conservation Site approach aims at preserving the ecological functions of the remaining forests as well as improving the livelihoods of local populations dependant on these resources. The management goals of the Conservation Sites are identified following the three main functions of the forest: production function (e.g. timber forest exploitation), regulation function (e.g. preventing erosion), and conservation function (e.g. protection of key habitats). Biological, socio-economic and geographic information at national, regional and local level are spatialized and combined through GIS modeling to define zones with different types of forest uses.

The case of Zahamena-Mantadia Conservation Site, 350,000 hectares of forest corridor, has been analyzed to demonstrate that in comparison with the current forest management practices, the creation of the Conservation Site with multiple forest uses can generate greater socio-economic benefits to support the sustainable development of the region. The establishment of the Conservation Site integrates the environmental dimension in the regional development plan to value and use the natural resources in the most sustainable manner. Different management regimes will place various types of pressures on stakeholders of differing socio-economic status and power. Taking into account the analysis of

costs and benefits of conservation on these stakeholders was important to define management options for the Zahamena-Mantadia Conservation Site. On the other hand, permanently threatened by the conversion of forests to agricultural lands, the Conservation Site management system must prove its efficiency in maintaining the connectivity of the forest corridor and its ecological services to form viable habitats for this biodiversity richness unique in the world.

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Changes of Dung Beetle Communities from Rainforests towards Agroforestry Systems and Annual Cultures

Little is known how tropical land-use systems contribute to the conservation of functionally important insect groups such as dung beetles. In a study at the margin of Lore Lindu National Park (a biodiversity hotspot in Central Sulawesi, Indonesia) dung-beetle communities were sampled in natural forest, young secondary forests, agroforestry systems (cacao plantations with shade trees) and annual cultures (maize fields), each with four replicates (n= 16 sites). At each site 10 pitfall traps, baited with cattle dung, were exposed along a 100 m transect six times for three days. The number of trapped specimens and species was higher at the natural forests sites compared to all other habitats, which did not show significant differences. Each land-use system contributed on average 75% of the species richness found in the natural forest, thereby indicating their importance for conservation. However, a two-dimensional scaling plot based on NESS indices (m=6) indicated distinct dung beetle communities for both forest types, while agroforestry systems and annual cultures showed a pronounced overlap. Although five of the six most abundant dung beetle species (>20 collected specimens) could be recorded in all habitats, the abundance of five species was significantly related to habitat type. Mean body size of dung beetles was not related to land-use intensity. Mean local abundance and number of occupied sites were closely correlated, further indicating little habitat specifity. The low dung beetle diversity (total of 18 recorded species) may be due to the absence of larger mammals on Sulawesi in historical times (although Sulawesi is the largest island of Wallacea). In conclusion, the dung beetle fauna of the lower montane forest zone in Central Sulawesi appeared to be relatively robust against man-made habitat changes and the majority of species did not exhibit strong habitat preferences.

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Diversity Changes of Dung Beetle Communities from Rainforests to Land-Use Systems in Indonesia

Little is known how tropical land-use systems contribute to the conservation of functionally important insect groups such as dung beetles. In a study at the margin of Lore Lindu National Park (a biodiversity hotspot in Central Sulawesi, Indonesia, 1100-1200 m asl), dung-beetle communities were sampled in natural forest, young secondary forests, agroforestry systems (cacao plantations with shade trees) and annual cultures (maize fields), each with four replicates (n= 16 sites). At each site 10 pitfall traps, baited with cattle dung, were exposed along a 100m transect six times for three days. The number of trapped specimens and species was higher at the natural forests sites compared to all other habitats, which did not show significant differences. Each land-use system contributed on average 75% of the species richness found in the natural forest, thereby indicating their importance for conservation. However, a two-dimensional scaling plot based on NESS indices (m=6) indicated distinct dung beetle communities for both forest types, while agroforestry systems and annual cultures showed a pronounced overlap. Although five of the six most abundant dung beetle species (>20 collected specimens) could be recorded in all habitats, the abundance of five species was significantly related to habitat type. Mean local abundance and number of occupied sites were closely correlated, further indicating little habitat specifity. The low dung beetle diversity (total of 18 recorded species) may be due to the absence of larger mammals on Sulawesi in historical times. However, samples from another site and using anoa (dwarf buffalo) and cattle dung as a bait, we recorded a more diverse dung beetles with 36 species totally, but in a similar diversity pattern, i.e the species richness and abundance of dung beetles at natural forest was higher compared to all other land use systems. In conclusion, the conversion of rainforest to man made land use systems tend to reduce the diversity of dung beetles in lower montane forest zone in Central Sulawesi but the majority of species did not exhibit strong habitat preferences.

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Forest Resource Management between Conservation and Poverty Alleviation: Simulation Results from the Northwest of Madagascar

This study examines alternative forest management policies from the viewpoint of rural households in Madagascar using economic as well as ecological simulation analyses. Based on a poverty index to account for relative poverty levels among the households, the results demonstrate that due to their livelihood strategies it is especially the poorest households that suffer most from a strict conservation approach, while better-off households benefit more from an improved provision of indirect forest services, particularly the protection of watersheds. It is not even possible to off-set this effect by compensating households for their opportunity costs as currently envisaged by national policy makers and international donors in Madagascar. Policy implications are discussed.

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Discount Rates, Patterns of Sustainability, and the Environmental Kuznets Curve - Implications for Achieving Sustainable Forest Management in Developing Countries

This paper explores the interrelationship between discount rate regimes and different patterns of sustainable forest management outcomes. In contrast to the static analyses of discount rates that have been carried out so far, this paper establishes a theoretical framework that analyzes dynamic changes of discount rates and its implications for achieving sustainable forest management in developing countries. Due to the significant impacts of discounting regimes on forest management, the strong advantage of this framework is that it allows the analysis to differentiate between different pathways of sustainability recognizing the economic decision-making environment of rural households in developing countries. Therefore, the results of this study contribute important knowledge about the patterns of forest management – weak or strong sustainability – that can be expected when dynamics of discount rate regimes are taken into consideration. The results indicate the existence of an Environmental Kuznets Curve (EKC) with regard to forest resource management. The general dynamics of forest management that can be concluded from the existence of an EKC also demonstrate that – depending on the prevailing discounting framework – varying combinations of livelihood and environmental outcomes have to be presumed. Therefore, the results of this study allow to conclude and propose important implications for the design of appropriate policy measures to optimize forest management in developing countries. These policy measures are separately discussed with regard to pathways of sustainability and combinations of livelihood and environmental outcomes.

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Impact of National Economic Growth on Greenhouse Gases Formation and Capacity Degradation of Economic Sectors in Indonesia

It has been proven that national economic growth which is originally expected to improve people welfare, to balance the gaps of income, to alleviate poverty and to keep the environmental stability could not accomplish the goal of economic development. The objectives of this reasearch are : (1) to analyze the impack of nasional economic growth on greenhouse gases formation, especialy on emission of carbon, sulphur and nitrogen, (2) to analyze the impack of greenhouse gases emission which is formed by economic activities as consequences of national economic growth on the capacity of economic sectors, especialy in declining capacity on output, income, value added and employment. To prove those main objectives, the national Input-Output analysis is used in this research. The data used in this research are input-output transaction matrix year 1980, 1985, 1990, 1995 and 2000 which is published by Statistical Center Agency (BPS). Input-Output data analysis showed that with 4.24% of economic growth scenario formed carbon, sulphur, and nitrogen each equal to 3,276.6 kilo ton, 44.2 kilo ton, and 79.9 kilo ton respectively. By internalyzing the price of carbon Rp 190,000 per mt, they would decline the capacity of economic sectors, such as Rp 1.4 triliun of ouput, Rp 187.9 biliun of income, Rp 657.2 biliun of value added and 33.728 persons of employment respectively. In conclusion, economic growth has caused the greenhouse gaseous formation, and has implication on cost of externalities on environment. Furthermore, the policies to compensate the recovery of environmental degradation is needed through some instruments of policies, such as command-and-control, and based-market-policies in Indonesia.

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Agrarian Change and Gendered Local Knowledge: The Shift of Domination

This is an analysis of the interconnectedness between gender, knowledge, and power in the management of forest margin located along Kulawi Valley in the Western border of Lore Lindu National Park, Central Sulawesi. It is found that "Revolusi Cokelat" (Cacao Revolution) or the shift from rice (subsistence) to cacao (petty commodity) production provides a basic context for the constellation of gendered local knowledge in Kulawi community, Bolapapu village. Rice farming, which is women's domain, and therefore women's knowledge, has been devalued since cacao farming was introduced as a commercial commodity. The economic attributes have defined 'the valued knowledge', and it became men's domain of knowledge.

The separation of knowledge domain derives from a gender norm that puts women in a reproductive role and men in a productive one. But, the 'value' comes after capitalism enters village's economy. Rice in Bolapapu has never been commercial, but used to be important as an exchange tool. When the type of village economy has already shifted into a production-for-commercialism through the introduction of cash and export crops, the economic value establishes a hierarchy between subsistence (domestic) and commercial (public) work. Progressive cacao farmers consider rice farming as a less valued activity because it does not produce profit. This devaluation is going hand in hand with a devaluation of the related sphere of knowledge.

The implication of this knowledge inequality is the domination of market valued knowledge. Such domination produces household's agricultural decisions that favor the expansion of commercial commodities to the forest. This decision could be interpreted as a reflection of ignorance. However, it is not the case. The women of Bolapapu are well aware of the importance of the forest to provide water for their rice fields. But, the domination of cacao farming has somewhat 'concealed'such knowledge and awareness. This is a call to understand further the constellation of gendered local knowledge. The 'concealed link' between rice fields and the forest could become a threat to the community's socioeconomic security as well as ecological stability of the rainforest area. And this could be a cost that has to be paid by the expansion of petty commodity to Bolapapu's village economy.

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Influence of Habitat Structure on the Predatory Macroarthropod Community along a Land Use Gradient (Cacao Plantation to Natural Forest) in Central Sulawesi

Spiders are top predators in the soil food web and they are among the most abundant macroarthropod predator groups in tropical rain forests beside beetles and ants. Data from the literature show that the abundance of ants and spiders in tropical plantations is reduced while the ratio between the two groups remains the same compared to natural forests. This study evaluates the influence of land use change from natural rain forest to cacao plantations on the spider communities in Central Sulawesi.

A litter exchange experiment was designed to examine how changes of habitat structure and stand climate would affect spider communities. Before the start of the experiment litter was collected from natural forests and cacao plantations and defaunated by careful drying. The material was spread as one species litter and as a mixture on three 1m² plots in each of the four replicates of the following forest types and agroforestry systems: natural forest, natural forest with lighter gaps and cacao plantation under natural forest trees. We took one sample after three and six weeks from each litter plot and three samples from untreated surrounding litter at each sampling date. Animals where extracted using Winkler-traps, and spiders are being identified to species/morphospecies level.

Data from studies in temperate zones show that different litter types result in different colonisation rates of spiders, indicating that higher litter heterogeneity can be the cause for higher spider abundance and diversity. Thus we expect a higher abundance and diversity of spiders in the divers natural forest litter compared to the cacao litter. Additionally we predict a higher abundance of spiders in the treated litter compared to the controls in the beginning of the experiment because there would be more space for colonisation available due to the absence of occupied spider territories. Also, the interaction between ants and spiders as predatory groups will be discussed in regard to litter habitat structure and land use change.

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The Use of Forest Products: Evidence from the Vicinity of the Lore-Lindu National Park, Central Sulawesi, Indonesia

The Lore-Lindu National Park (LLNP) in Central Sulawesi, Indonesia, hosts some of the world's most unique plant and animal species, but agricultural activities and the extraction of forest products are threatening the ecosystem functions within the park. However, empirical evidence from other areas suggests that forest products play an important role as a source of income for rural households. This paper analyses the importance of forest products, especially for the rural poor, and identifies the underlying factors which drive households into the forest. Moreover, the paper investigates similarities and differences in the use of forest products in the village of Toro, where an agreement with the national park authority on the use of forest areas exists, and in the research area, where such agreements did not exist.

Specifically, the following research questions will be addressed: (1) Which forest products are gathered and sold? (2) How important are forest products as a source of income? (3) Do poor households differ in this respect from better-off households? (4) Which underlying factors influence participation in the sale of forest products? (5) What are the similarities and differences in the collection and sale of forest products between the village of Toro and the research area?

In the vicinity of the LLNP, 76% of the households collect forest products, with firewood being the most important product. The sale of forest products contributes only 7% to the total household income of all households, with 17% of the households participating in this activity. Differentiating this average figure by wealth groups shows the importance of forest products, especially rattan, as a source of income for the poorest households. 21% of the total household income of the poorest households originates from the selling of forest products and 30% of these households reported to have income from forest products. Participation in the sale of forest products is significantly influenced by the area of wetland, the education of the head of the household, ethnicity, and access to road infrastructure. An additional hectare of wetland owned decreases the likelihood of participation in the sale of forest products by 15%, since the production of rice is very labour intensive. Belonging to a non-indigenous ethnic group decreases the probability of participation in the sale of forest products by 8%. Every hour of

increased distance to the road decreases the probability of participation by almost 2%. The latter result is somewhat surprising because in general, forest products are associated with remote areas. However, here we only considered the sale of forest products, which requires good road infrastructure.

Based on participatory mapping, land use and the extraction and utilisation of forest resources was defined for the entire area claimed by the villagers of Toro as being their customary village land in the year 2000. Nevertheless, after 4 years of implementation the share of households collecting forest products is higher in Toro (93% of the households) than in the research area (76%). But, the share of these households which sell their products is much lower in Toro. Whereas in the research area 22% of all households collecting forest product also sell them, this share is only 11% in Toro. Moreover, the mean sales value is also much lower in Toro (IDR 0.49 mill) than in the research area (IDR 2.38 mill).

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Effects of Forest Clearing on Soil Organic Carbon Dynamics in Central Panama: Evidence from Incubations and Stable Isotopes

Tropical forests play an important role in the global carbon budget. About 20% of global soil organic carbon is located in tropical areas. Forest clearing in tropical regions is estimated to contribute about 23% to human-induced CO2 emissions. Although many studies have been published on soil carbon inventories following forest conversion to pasture, data on turnover rates are still lacking. Our objectives were (1) to estimate the size of active, slow and passive carbon pools and (2) to determine if the rate of turnover of the different carbon pools is affected by forest clearing.

Assessing carbon dynamics using laboratory incubation and stable isotopes

Combining incubation techniques with the 13C natural abundance offers an approach to quantify active (highly labile pool with turnover times of less then 10 years) and slow soil organic carbon pools (turnover time from 10 to 100 years) and estimate turnover rates (Paul et al. 2000). Long-term incubations of soil utilize the degradative capacity of the soil biota's enzymes to release the active and slow soil organic carbon pools. The 13C natural abundance technique can be applied in plant/soil systems where the 13C signal of the carbon input is different from that of the natural soil organic matter, for example, where C4 grass (δ13C = -14 ‰) grow on soils derived from a C3 vegetation (δ13C = -28 ‰).

The study was done at Barro Colorado Island (BCI), Central Panama. We choose paired plots in forest and clearing at three positions along the hill slope. The conversion from forest to grassland (clearing) occurred approximately 90 years ago. The soils are classified as Oxisols with a pH ranging form 4.5 (subsoil) to 6.0 (topsoil). Samples were taken from six soil pits at 0-5 cm, 5-10 cm and 30-40 cm depth. Moist, sieved soil samples were incubated at 25 °C for six months. The pool size and turnover rates of the active and slow pool were determined by curve analysis of the CO2 emitted per unit time. We used nonlinear regression (SAS PROC NLIN) with a two-pool constrained model to analyze the CO2 data. The passive carbon pool was estimated using acid hydrolysis. 13C signatures in respired CO2 were measured using a GC-IRMS. Calculation of the carbon dioxide derived from natural forest (old carbon) and clearing (new carbon) was done using a two-source mixing model (Balesdent & Mariotti 1996, Phillips & Gregg 2001).

Changes in soil organic carbon pools, turnover rates and 13CO2 following forest clearing

The active soil carbon pool in the topsoil and subsoil of both, undisturbed forest and clearing, was less than one percent of total soil carbon. The turnover rate of the active carbon pool was approximately 2 days in the subsoil and 6 days in the topsoil. Under forest and clearing the passive carbon pool ranged from 30 to 60%. In the topsoil, the slow carbon pool ranged from 30% (clearing) to 40% (forest) of total soil carbon. Forest clearing resulted in faster turnover of the slow carbon pool. In the topsoil of the clearing, we estimated a turnover rate of 6 years as compared to 10 years in the forest. Slower turnover of forest soils was also observed in the subsoil. The heterogeneous nature of soil carbon and changes in biotic and abiotic factors due to forest clearing might explain the difference in turnover rates.

Land-use history significantly affected the δ13CO2 signatures of the respired CO2, especially in the topsoil. δ13C values of CO2 emitted from undisturbed forest were around -25 ‰. Carbon dioxide emitted from the topsoil of the clearing was more enriched in δ13C (-18 ‰). Approximately 80% of the respired CO2 in the clearing is derived from the actual C4 vegetation.

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Effects of Tropical Rainforests Conversion on Butterflies, Trees and Understorey Plants Communities in Southwestern Cameroon

Man-made systems are becoming more and more commun in tropical rainforest regions as a result of rapid forest conversion. Frugivorous butterflies, trees and understorey plants were studied on 24 sampling stations distributed over near-primary forest, secondary forest, agroforestry and annual culture sites in the Northeastern part of Korup region, SW Cameroon, to assess the impact of forest conversion on the diversity and abundance of the studied groups. We found that butterfly richness and abundance were highest in secondary forest and agroforestry sites and significantly lower in near-primary forest and annual crop sites. Tree species richness decreased significantly from forest to farmland, being highest and almost equal in secondary and near-primary forests. Understorey plant species richness was significantly higher in annual crop farms than in other land use types. The four land use types differed in butterfly, tree and understorey plant species composition, the difference being smaller between near-primary and secondary forests. Butterfly species richness increased significantly with increasing tree density, but seemed to decrease with increasing herb diversity at annual crop farms. A significant negative correlation was found between butterfly geographic range and their preference for near-primary forest sites. Our results also showed that agroforestry systems, containing remainings of natural forest, can help to sustain high site richness and to protect many forest species, and that especially annual crop lands could be redesigned to improve biodiversity conservation in tropical agricultural landscapes.

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Discursive Strategies and Local Power in the Politics of Natural Resource Management: The Case of Moma Sub-Ethnics Communities in Western Margin of Lore Lindu National Park, Central Sulawesi

Since the government recognized Toro's indigenous claim over their ancestral territory in 2000, the community have been mobilizing some efforts to strengthen and affirm their claim. These were done by articulating and reproducing their customary identity and institutions, especially those related to the organization of natural resource appropriation. As such, the revitalization of Toro's cultural identity in controlling and managing local resource is not simply a return to ancestral custom. Rather, it is a cultural politics articulation which involving a very notion of "cultural reproduction" process. In this process, the cultural identity was reinterpreted and redefined, and the allocation of local power and resource was negotiated and reshaped.

In fact, as Toro people is part of several communities belong to Moma sub-ethnics living in Kulawi sub-district, the above articulation of cultural politics represented just one of discursive strategies in claiming territory being declared as national park by central government. However, given the state recognition of Toro's ancestral rights, the discursive and social practices mobilized by Toro people became the "exemplary model" in any talking about the kearifan tradisional pengelolalan sumberdaya alam (traditional ecological wisdom) of Kulawi culture. This newly gained position had factually challenged the local power and traditional authority of Moma sub-ethnics centered in Bolapapu, the capital of Kulawi sub-district and the center of Kulawi's pre-colonial royal.

Therefore, this paper will discuss those contesting representations upon culture and space and their strategic use by different actors. The paper will highlight this politics of natural resource management both in terms of inter-community relations (i.e., among Toro, Bolapapu, Mataue, Sungku, and Marena people) and intra-community relations (i.e., among different actors within Toro community itself).

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Ecological Adaptation by Different Ethnics and its Impacts on Land Use and Economic Security: Adaptational Processes of Seko and Daa Ethnics in Palolo Valley, Central Sulawesi

The modes of ecological adaptation in frontier areas for some extents directed by the "culture core" of different immigrants in their origins; i.e., their patterned behavior and culture in exploiting and managing the resource. Since these patterns of behavior have been symbolized and reified in the religious belief system and other meaning systems, their existence often endured in other contexts differ to the original situation.

This paper will exploratively compare two immigrant ethnics in Palolo valley, that is, Seko and Daa ethnics. These two ethnics differ in their ecological background and mode of land cultivation. Seko people came from Seko valley in the South Sulawesi and known for their strong tradition in wet rice cultivation. Meanwhile, Daa people were shifting cultivators in the mountainous area of Gawalise in western Palu.

Therefore, this paper will focus on the adaptational process of two ethnics in the new ecosystem. The preliminary findings conclude that Seko ethnics have developed more stable adaptation ecologically and more capital and land accumulation economically than Daa ethnics have. The factors driving this contrast situation between two ethnics will be the main subject of this paper to discuss.

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Influence of Microclimate Change on Ant Communities in Litter Habitats Along a Tropical Land Use Gradient from Cacao Plantations to Natural Forest

Ants are the most abundant arthropods in tropical rain forests. As top predators in the tropical soil food-web and decomposers of dead organic material they play an important part in carbon-turnover. Agricultural land-use like plantation farming influences the natural ant community due to the change of the microclimate caused by the loss of natural vegetation and different shade situations in plantations. This study examines the effect of different shade treatments on ant diversity and ant abundance in cacao plantations in Central Sulawesi.

To examine the influence of the microclimate change, we set up water permeable shade-roofs at three different areas: natural forest, cacao plantation under natural forest trees and cacao plantation under planted shade trees.

After one month we extracted the animals from the litter under the roofs and from control plots (natural shady and sunny plots) using Winkler traps. Additionally, we counted the number of ant nests in the soil under different shade conditions.

During the month of shade manipulation, ant activity under shade-roofs and in control plots was measured using fish and honey baits. To estimate activity, the baits were offered for a definite time (1/2 h) and ants feeding on the bait were collected and stored in 70% ethanol. Animals were counted and identified to species/morphospecies level. Abundance and diversity will be calculated.

We expect a higher ant diversity in the natural forest than in plantations and hypothesise that the ant community in plantations will be dominated by only a few ant species while forest communities will have a more even distribution of species.

Data from the literature indicates that manipulation of radiation could result in dramatic community changes in such a way, for example, that species actively abandoned the shaded nests while other species created nests in the newly formed shade.

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Legal Aspects of Data Management in International Interdisciplinary Research Projects and Implementation in SFB 552 "Stability of Rainforest Margins" (STORMA)

Managing research data constitutes an essential component in international scientific projects but raises a number of legal problems resulting from conflicting interests and rights to the data.

It is the subject of this contribution to illustrate the contradicting interests and elucidate how international regulations on intellectual property such as copyrights or rights resulting from patents or competition law as well as sovereign rights by states, groups or individuals other than the project members involved, apply to research data. Assessing the scope of the legal protection framework and the kind of regulations concerned it will be pointed out which options and mechanisms can be employed in order to achieve a coherent management system.

Implementation in SFB 552 "stability of rainforest margins" (STORMA)

STORMA, an international interdisciplinary research co-operation between four universities in Germany and Indonesia, aims to an integrative and comprehensive research approach including a central data management and information system. On the Basis of a Memorandum of Agreement (MoA) the parties adopted a Protocol of Data Exchange (PDE) determinig a right and ownership of STORMA to all collected data and a duty of project members to provide STORMA with project data and meta data. Accommodating the interest of access to the data, the PDE offers a bilateral exchange between different sub-projects as well as the use of a common data pool.

In contrast, the Protocoll provides the collecting scientist to retent the submission of the data for a one year duration in order to enable the exclusive scientific use at first.

Furthermore, the PDE contains regulations in respect of third party access and provisions as to existing copyrights and rights regarding authorship. The Implementation and Enforcement of the Protocoll inter alia includes the exclusion from further funding or dismission from STORMA.

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Forest Growth, Economic Growth and Public Policy

Although deforestation and forest degradation are evident in many places throughout the world, forest cover in India has increased in the last few decades defying common wisdom. The Indian experience is an establishment of the fact that deforestation can be reversed even at fairly low levels of national income. There seems to be no disagreement on the rise of forest, but what is debatable is the mechanism that rise forest cover in developing countries. Is it economic growth as suggested by the previous empirical literature or public policy that is predicted by the theoretical literature on growth and environment, but in the broader context of international trade? This paper supports the latter that substitution effect caused by the restrictive nature of ownership pattern of forest resources through public policy can reverse deforestation even at fairly low levels of national income in developing countries.

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The Socio-Economic Impact of El Niño Southern Oscillation (ENSO) on Rural Households in Central Sulawesi

ENSO represent one of climate variability phenomenon, drought because of ENSO has been noted as a bad effect for Indonesian food security. With uncertain situation for forecasting occurrence of ENSO, information of vulnerability area and socio-economic characteristics shall become attention of government. If vulnerable area can be determined, that area can be made an especial priority in the effort mitigation affect of ENSO, so the study about the socio-economic impact of ENSO on rural household in Central Sulawesi need to be explore.

The main objective of this study are to measure the risk of drought, to investigate the coping strategies taken by rural households, to measure household resilience toward drought period and to identify factors which influence drought resilience. To measure household drought resilience, this study construct Drought Resilience Index (DRI) derived by Principal Component Analysis based on the consumption expenditure related indicators, and then apply an asset-based livelihood framework to identify farmer resilience determinants using correlation analysis.

This research is using secondary data from IMPENSO (IMPact of ENSO). The sample comprises eight villages in two watersheds, which were selected using stratification criterion by elevation above sea level. Total respondent 228 households, but only 188 had ever experience a drought and had suffered a yield decline or not plant any crop due to the drought. The ENSO event is being analyzed depends on which is claimed to have been the most severe by respondent. In approximately 70% of this cases is the 2002 event. However, in their perception, respondent may have been biased towards the most recent drought (i.e. the 2002 drought), although climatic data (Southern Oscillation Index) indicate that the 1997/1998 ENSO was more severe.

Drought periods in Sigi Biromaru being significantly longer and the most severe than in the other two sub-districts. On the average, drought period caused the yield of both irrigated rice and cocoa to decline to approximately 70% of their usual level. The yield decline in Sigi Biromaru was more pronounced than in Palolo and Kulawi. There are significant difference between sub-district because of the geographically, sub-districts Sigi Biromaru (the low-lying Palu valley), sub-district Kulawi (600-1000 m.a.s.l.) and sub-district Palolo (550-650 m.a.s.l.).

The most coping strategy employed in order to cope with reduced agricultural

income due to the drought are reduce expenditures for food and other basic necessities and followed by respondent earned income from additional income, mostly through temporal employment.

The construction of Drought Resilience Index (DRI) derived via Principal Component Analysis based on the consumption and expenditure related indicators. The DRI is a relative measure of drought resilience within study sample, DRI have positive correlated with household resilience, the smaller the index, the less resilient (i.e. the more susceptible) a household is. The minimum value in this index was –2,52 and maximum value of 0,94 is attained by those 72 drought-affected households (38% of population in the sample), which did not reduce any expenditure.

Based on socio-economic characteristics, DRI have positively correlation between labor capacity, total value of household assets possesses, total loan amount used for agricultural inputs and total amount spent on clothes expenses. But DRI have negatively correlation between amount of credit available to household and child dependency ratio. Based on topography characteristics, DRI have positively correlation between elevation above sea level, total area cultivated during drought period and ratio yield share during drought period.

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Global Tourism and the Disappearance of Coastal Rainforests: A Story of Intensifying Natural Desasters!?

Coastal tropical forests play a similar role in protecting local communities against threatening impacts of natural hazards like mountain forest play in protecting local alpine communities against avalanches. But similar to negative developments in wintersport tourism in the European Alps during the 1980th and 1990th coastal tropical rainforests were destroyed in large scales for tourism purporses. The sometimes punctual, sometimes strung-together designed construction of beach resorts and beach destinations in tropical South and South East Asia - as well as in tropical Latin America - created geographical and ecological scares in these sensitive landscapes and ecosystems. But in socio-economic terms these developments were very attractive to many of the regional population, thus a huge migration into these ecological scares appeared and the severe threatening of the coastal environments was enlarged. The tourism industries brought economic changes but also hazards. The tourism-induced coastal developments disregarded the negative consequences provoked by a destroyed coastal ecosystem in which the coastal rainforests and the mangrove forest played a protective master role. The Boxing-Day-Tsunami taught a very tough lesson to the coastal communities. Ignoring and disregarding the growing danger over years the local population was not able to read and understand the signs of a upcoming desaster. But global tourism has to learn the lesson too. To be sustainable tourism in tropical coastal rainforest areas has to adapt itself to the vulnerability of that specific environment. The tourism industry must understand the necessity of a natural protection systems against the - natural but man-made reinforced - harms and dangers. One can not prevent the next tsunami but one could prevent the worst impact of such an event - the death of tousands of foreign beachfront tourists and local coast dweller. Ecological and geographical education for the locals, the tourist and the tourism makers as well as the protection of the remaining coastal rainforest and mangrove forest and reforestation are the keys to a sustainble tourism with lesser desaster risks in tropical coastal areas

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Impact of Forest Disturbance on Soil Fauna along a Land Use Gradient in Central Sulawesi, Indonesia

In order to assess the influence of forest disturbance on the soil fauna and decomposition processes a study was conducted at the rainforest margin zone of the Lore-Lindu National Park, Central Sulawesi. Along a land use gradient consistent of four levels of disturbance (natural forest to intensively managed plantations) soil core samples from different horizons (0-3 and 3-6 cm, respectively) were taken and extracted by heat. The extracted animals were sorted in taxonomic groups and oribatid mites and collembolans were further determined. Additionally, leaf litter was extracted to assess the abundances of soil macrofauna. Further, soil characteristics (Al, Ca, Fe, K, Mg, Mn, Na, CECeff, C/N, pH, soil water content), litter depth and temperature in 10cm height were measured.

Preliminary results show that the composition of soil fauna changes along the land use gradient. Abundances of oribatid mites and collembolans were significant higher in forest stands than in plantations. Soil nutrient contents and pH were conditioned by the soil type. The soil water content and the litter depth significantly decreased with increasing land use intensity whereas the daily mean temperature increased.

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Change Detection of Forest and Habitat Resources from 1973 to 2001 in Bach Ma National Park, Vietnam, Using Remote Sensing Imagery

Land cover changes have not been well documented in Vietnam. Here, we present new crucial information relevant to land cover modifications and to resource inventory such as forest management and wildlife habitats. Formed in 1991, Bach Ma National Park and its buffer zone is one of the richest regions for biodiversity in Asia, providing habitat for endangered and other species of conservation concern such as tiger (Panthera tigris), red-shanked douc langur (Pygathrix nemaeus), saola (Pseudoryx nghetinhensis), giant muntjac (Megamuntiacus vuquangensis), and several species of endemic pheasants. Herein, we attempt to assess the major forest cover changes using Remote Sensing Imagery (Landsat: MSS, TM, +ETM) between the years prior to the establishment of national park status and the years following. Normalized Difference Vegetation Index (NDVI) was used across sensors; for the study area we identified five regions where major land-cover changes have occurred. Between 1973 and 2001 we estimate conservatively that approximately 45 % of the buffer zone was modified, or lost its forest cover, with most changes occurring around 1989 just prior to the park establishment. These changes likely can be attributed to forest and resource extrapolation that coincided with a high human density and is supported by extensive road building in the surrounding region. More research is needed to improve presented approaches in order to better safeguard forested landscapes in Vietnam and elsewhere.

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