



# NEWS

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### FORESTS AND WATER



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Dear readers,

For this issue on "Forests and Water" I would like to start by thanking all contributors for their time spent and fine collaboration in editing.

The relation of tropical forests and water is crucial in many aspects. However, the response to the call for contributions has not been as overwhelming as for the previous issue of the newsletter on "non timber forest products". Perhaps this is because water issues are not as "hot" today as other issues to the community forming policy for priorities for research. Water issues have been identified high on the agenda for many decades, but maybe too long for research to develop? The benchmark symposium and workshop in Kuala Lumpur, August 2000 (see report inside and reports on the web), identified the need for scaling up to landscape level and to clarify the links and effects to society. Not that we do not need more understanding of technical processes working within catchments, but how do they link and how are they relevant to poor people's living and development in the ecosystems of today? Sadly, much of what was forests in the past is not forests today. What are the dynamics of people, fire, vegetation, water and nutrients in the dominating secondary and manmade ecosystems of today and in changing societies? Much research is done on effects of land use practices and processes in natural systems, but what about wild fires raging the tropical continents in more fire prone new vegetation types?

The contents of this issue reflect a broad spectrum of forests and water. A number of articles report on the classical type of catchment experiments. These reports underline the importance of long term research and also aim at welcome efforts to coordinate catchment programmes.

Several key ecosystems, small but important, are covered. These include cloud forests (publications), wetlands and mangroves, but also forest plantations, which will be increasingly important with vanishing natural forests and land in need of "rehabilitation".

Issues of water conservation pertain as major issues in the dry tropics and they are also covered in this issue. Finally, a paper on arthropods in the trees has been included as this interesting subject has not been covered in the ETFRN News for some time.

I hope you all will have interesting reading and get new impulses.

Anders Malmer  
Dept. of Forest Ecology, Swedish University of Agricultural Science, Umeå, Sweden.

We are grateful to Anders Malmer for editing this issue of the ETFRN News. Please note the themes and deadlines for the next issues on the back cover.

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Cover illustration:

Forest stream in multi-layered dipterocarp forest in Sabah, Malaysia.

Photograph by Anders Malmer.

### EC NEWS

#### DG Research

***Preparations for a new EU framework programme for Research and Development*** are reported to be on schedule. The launch of the 17.5 billion Euro Research Framework Programme for 2002 – 2006 is planned for mid 2002.

The following research areas have been identified as priorities for the framework programme:

- ***Genomics and biotechnology for health***
- ***Information Society technologies***
- ***Nanotechnologies, intelligent materials and new production processes***
- ***Aeronautics and space***
- ***Food Safety and health risks***
- ***Sustainable development and global change***
- ***Citizens and Governance in the European Knowledge-based society***

While the topic of sustainable development and global change could potentially include forest related research in the tropics, subtropics and Mediterranean, the present Commission proposals do not appear to pay specific attention to research cooperation with developing countries.

The research funding methods will not be the same as in the present framework programme. The new programme aims to help create a European Research Area by means of three key instruments:

***Networks of excellence*** – networks of researchers around a core group of participants, aiming to advance knowledge in a particular area by assembling a critical

mass of skills – research activities oriented towards long-term objectives, rather than precise, predefined results

***Integrated projects*** (in the range of several million to several tens of millions of Euros)

***Joint participation in national programmes*** – involving at least three Member States, or two Member States and one Associated State

Information on the Commission's proposal for the new framework programme (2002-2006) is available from:

<http://europa.eu.int/comm/research/nfp.html> where the following documents may be downloaded. The documents are available in all EU languages.

- Commission's proposal for the new framework programme: COM (2001) 94 of 21.02.2001
- Communication from the Commission: the framework programme and the European Research Area: application of Article 169 and the networking of national programmes: COM (2001) 282 of 30.05.2001
- Commission's proposal for the specific programmes: COM (2001) 279 of 30.05.2001

*A dedicated e-mail address has been created at DG Research to which comments and suggestions may be sent:*  
[research-nfp@cec.eu.int](mailto:research-nfp@cec.eu.int)

**DGs Development and Europe-Aid Cooperation Office (formerly SCR)**

***The Tropical Forest Budget Line*** call for proposals for 2001 closed last May.

According to Commission sources, around 700 proposals were received, and evaluation will commence early September, after the summer holiday period.

### DG Environment

#### ***Report available: Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change***

The objectives of this 2 year long study were to identify the (least-cost) contribution of different sectors and gases for meeting the European Community's quantitative reduction for greenhouse gases under the Kyoto protocol; and to determine a package of cost-effective policies and measures for all sectors and gases towards meeting the goals.

The study is available from the DG Environment website at:

[http://europa.eu.int/comm/environment/enveco/climate\\_change/sectoral\\_objectives.htm](http://europa.eu.int/comm/environment/enveco/climate_change/sectoral_objectives.htm)

Carbon sinks were not taken into account. The study highlights include the following statement: "Further work is required by expanding the coverage to include carbon sinks, to look beyond 2010 and to include the accession countries in the analysis."

Further information on EU policies and activities regarding climate change is available from DG Environment's Climate Change page:

[http://europa.eu.int/comm/environment/climat/home\\_en.htm](http://europa.eu.int/comm/environment/climat/home_en.htm)

### ETFRN NEWS

***ETFRN Topics pages: easy access to a***

***wealth of web-based information on non-timber forest products and on biodiversity.***

The new topics pages, on Non-Timber Forest Products and on Biodiversity, have been designed to improve access to the range of information on the ETFRN website, as well as to other relevant web-based information. To save on search time, all information on Non Timber Forest Products and on Biodiversity on the ETFRN site can be accessed from the topics pages. A page with direct links to the search results of databases maintained by other organisations, such as FAO, EIARD Infosys, ELDIS and WISARD is also included.

In the future we plan to add new topics pages on other subjects. We would very much welcome comments and suggestions for further improvement, and for topics to cover.

### Recent ETFRN publications

***Forestry, Forest Users and Research: New Ways of Learning***, edited by Dr Anna Lawrence is the first publication in the new ETFRN Series. The book provides a sampler of current research *with* forest users, and is a result of the ETFRN workshop "Learning from Resource Users: a paradigm shift in tropical forestry?" which was held in Vienna on 28-29 April 2000. For more information, please see p. 46.

***Developing Needs-Based Inventory Methods for Non-Timber Forest Products: Application and development of current research to identify practical solutions for developing countries.***

The proceedings of the ETFRN workshop on this topic, which was held at FAO, Rome in May 2000 may be downloaded from the ETFRN website at

<http://www.etfrn.org/etfrn/workshop/ntfp/>

[index.html](#)

Printed copies are also available from the ETFRN Coordination Unit.

***The ETFRN Steering Committee meeting*** was held 9 - 10 February 2001 in Umeå, Sweden. Items discussed included plans for ETFRN workshops; the ETFRN web communication strategy; policy research links; and an approach to quantification of European research capability in forest research in the tropics, subtropics and Mediterranean.

At the end of the meeting the Chairman, Olavi Luukkanen (Finland) handed over the Chair to Jochen Heuveldop (Germany). Professor Luukkanen agreed to stay on the Executive Committee for one more year.

The Steering Committee unanimously elected Anders Malmer (Sweden) as Vice Chairman. Giovanni Preto (Italy) was nominated as fourth member of the Executive Committee. Approval for his nomination was unanimous, and Dr Preto

has accepted.

***The ETFRN Executive Committee meeting*** was held in Brussels 22 May 2001. Items discussed included workshop plans, ETFRN participation in the ASEM (Asia Europe Science meeting) conference on sustainable forest management in Asia, and DG Research preparations for the sixth framework plan for Research and Development.

The Executive Committee endorsed the following workshop proposals, and agreed to reserve 10–15,000 Euro from the Coordination Unit workshop funds for each of these workshops. For both proposed workshops, collaboration with other organisations or projects, and additional funds are being sought.

*Workshop on Dryland Rehabilitation in Sub-Saharan Africa*

*Workshop on Methods for Participatory Biodiversity Monitoring*

### **HYDROLOGICAL RESEARCH FOR INTEGRATED LAND AND WATER MANAGEMENT - UNESCO - IHP AND IUFRO SYMPOSIUM AND WORKSHOP**

*By Anders Malmer*

In hydrology research there is a need to scale up the level of investigation from plots and small catchments to a larger landscape level, in spite of the increased complexity, in order to be more relevant to the larger water problems and phenomena that face society. This was one of the general recommendations to the research community given by this five-day meeting.

The meeting, held in Bangi, Kuala Lumpur, Malaysia during five days in August 2000, was jointly organised by the UNESCO International Hydrological Programme (IHP) (as a contribution to the IHP-V Humid Tropics Programme and HELP – see p. 12 of this issue) and the International Union of Forest Research Organisation (IUFRO). The programme was devised to interface science with policy and management: in the opening session, an overview of the causes of land use change linked with policy, and the perspectives of a resource manager and local communities were delivered. Subsequent sessions enabled scientists to provide technical detail on hydrological processes in 'undisturbed' forest, and on the impact of various land use changes. New methodologies to evaluate the effects of land use change at different scales were then put forward based on experience both outside and within the humid tropics.

The final two days of the meeting were devoted to policy needs in a plenary session

followed by a workshop, which was co-organised and co-sponsored by the CGIAR centre CIFOR (Centre for International Forestry Research). The meeting was formally closed by Mr. Matsuura, Director-General of UNESCO, during his visit to Malaysia at the invitation of the Malaysian Government.

The production of a printed technical monograph based on the Symposium/Workshop by Cambridge University Press within the CUP-UNESCO International Hydrology Series has commenced, with a target date for publication in 2002. The production of non-technical materials (brochures, posters, audio-visuals) for policy makers and resource managers, summarising our current understanding of tropical forest hydrology and environmental effects of forest disturbance and conversion is under way.

Apart from general recommendations, presentations and discussions also resulted in recommendations on specific research issues eg agroforestry, water and energy scarcity, extreme events, tropical montane cloud forests, groundwater, etc. The paper by Bruce Aylward reported on in the 'Publications' section of this issue (p. 42) is an example of one of the papers on economic aspects of land use in watershed context.

Summary, recommendations, workshop overview and policy and management issues arising from scientific sessions of this meeting may be viewed at:  
<http://www.nwl.ac.uk/ih/help/kl/>

### **DANUM VALLEY HYDROLOGY PROGRAMME**

*By Nick Chappell & Kawi Bidin*

There are many popular misconceptions about the hydrological behaviour of rainforests and the impact of forestry activities on these aquatic processes. In part, this is because large natural variability (in space and time) makes it difficult to either extrapolate local observations to the landscape-scale, or identify purely anthropogenic change. To overcome these difficulties, work within tropical rainforests requires application of the best field and modelling technologies, not those that are easiest to resource.

One site where these fundamental issues are being addressed is the Danum Valley region of the Malaysian State of Sabah. Here, on Borneo Island, a group of Malaysian and UK scientists (notably Waidi Sinun, Ian Douglas and Tony Greer) established hydrological monitoring in 1986, as part of a joint enterprise between the Sabah Foundation and the Royal Society of London. The first projects were focused on the potential impacts of the first phase of selective, commercial forestry on the hydrology of lowland rainforest (Douglas et al., 1992 Phil. Trans. Roy. Soc. Lond. B.). This study and subsequent ecohydrological projects established a series of experimental catchments, ranging in size from the 44 ha Baru catchment to the 721 km sq. Segama catchment.

Analysis of the most recent Danum Valley data has shown that the local rainfall regime conforms to that expected of Equatorial region with relatively little annual seasonality and a dominance of short-

duration, convective storms that generate flashy river behaviour. Over distances of only a few kilometers, the rainfall exhibits a very high degree of spatial variability, being strongly moderated by the combined effects of monsoonal wind direction and topography (Bidin, 2001 PhD thesis). Additionally, El Niño Southern Oscillation (ENSO) phenomena give rise to cycles in the rainfall (Chappell et al., 2001 Plant Ecology) that become magnified in the river sediment records. Magnified partly by the changing incidence of extreme events (Douglas et al., 1999 Phil. Trans. Roy. Soc. Lond. B; Chappell et al., 2002 CUP-UNESCO).

Less than 5% of the incoming rainfall generates surface-flow away from stream channels, with almost all riverflow being generated only after rainfall has entered the ground. This flow is strongly related to the preferential pathways of natural soil pipes, percoline zones and rock fractures. Such routes are poorly characterised by traditional methods, and their presence in the Danum catchments has led to the development of new whole-hillslope, hydraulic tests (Chappell et al., 1998 Hydrological Processes). The role of such preferential or localised phenomena is also seen within the erosion / sediment system. The nested catchment structure utilised within the Baru, clearly demonstrated that over the long-term, a few landslides and smaller collapses were the key source of soil particles flowing down river channels (Chappell et al., 1999 Phil. Trans. Roy. Soc. Lond. B.). While soil-slope instabilities were observable within the undisturbed forest of the Danum Valley Conservation Area (Balamurgan, 1997 PhD thesis; Chappell et al., 1999b Soil Till. Res.; Tangki, 2001 MPhil) the incidence of collapses along timber-lorry, haulage roads seemed particularly high. The greater role of

landslides (triggered by changing subsurface-water conditions) relative to canopy disturbance and surficial erosion along skidder-vehicle trails may have important implications for the revision of current, sustainable forestry guidelines. Canopy disturbance did, however, impact on the evaporative transfers to the atmosphere. Surprisingly, greater rainfall reached the ground below undisturbed remnants of rainforest, relative to areas with a high degree of canopy change (Bidin 2001 PhD thesis). Such changes may be offset by reduced transpiration losses following disturbance and this is the focus of a series of new projects.

The role of extreme events, and the changing patterns of evaporation and erosion with forest recovery, underline the importance of continued monitoring at one of the few reference sites for lowland tropical rainforest.

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**ENVIRONMENTAL CARE PAYS OFF! A  
LONG TERM STUDY ON PLANTATION  
FORESTS IN SABAH, MALAYSIA**

*By Anders Malmer*

*Initiated in 1984, this joint project between the Department of Forest Ecology of the Swedish Agricultural University (SLU) and Sabah Forest Industry is today outstanding in terms of the long period of continuous monitoring of water and nutrient budgets of forest plantations established on former rainforest land. Not least, the research has produced illustrative results important for forming wise forest management policy.*

### **Background**

The research was started in 1984, demanded by Malaysian government and paid by Sabah Forest Industries (SFI) with the Department of Forest Ecology (FE) as subcontractor for a Swedish consultancy company: ÅF-IPK AB. During the first years a paired catchment study was set up for reference monitoring of similarity of hydrological budgets between catchments. Starting from 1986, the Swedish Agency for Research Cooperation (Sarec, presently part of Sida) has co-funded the study during four three-year periods and a final program grant (2000 - 2001).

### **A cascade of experiments**

In 1985 six catchments were established in lightly logged (1981, 10 trees/ha, resembling natural forest) dipterocarp forest and in such forest struck by forest fire in 1982/83. Three catchments were clear-felled and established with *Acacia mangium* plantation in 1987/88. Numerous process studies were performed in the growing plantations and the natural forest during the nineties, such as soil, biomass, litterfall and throughfall contents of nutrients, natural rehabilitation of tractor-disturbed soils, development of fine roots and mycorrhiza, etc.. In 1994 another five catchments were established in natural forest. Four of these were clear-felled in 1995, followed by shifting cultivation and *Acacia mangium* establishment combined



with one crop of hill rice (Nykqvist, 1993). A large experiment on man made rehabilitation of tractor disturbed soils was started in 1997.

### **Less fire and disturbance pays off!**

In 1987/88 one catchment was established where use of crawler tractors and fire was avoided. The most striking result was double tree production (Nykqvist et al., 1994). Undesirable effects such as runoff increases and streamwater siltation were also reduced by 50% (Malmer, 1996). Fire triggered large hydrological nutrient losses, almost double to those from the non-burned felled and planted area. The strong effect of fire was later confirmed in repeated experiments for nutrient losses (Malmer, *accepted*) and for tree production (Selamat, *in prep*).

Quick successful establishment of new forest is essential. Fire has been (and still is) the traditional means to establish a crop. However, this research shows that even though rearranging residues to be able to plant is costly, this was fully compensated by the reduction in weeding costs. The combination of better growth and residues covering the ground resulted in considerably lower competition by weeds during the first years (Nykqvist et al., 1994). Leaving residues is much easier when establishing the second rotation after harvesting as the amounts are less.

As a result of the research conducted, SFI no longer uses fire as a management tool in its plantations. However, this put an even higher pressure on quick establishment as it gives even less time ahead for the planted trees to the weeds. SFI is furthermore using cable yarders for plantation harvest to reduce soil disturbance.

### **Ca deficiencies and fire hot research**

### **issues**

One of the major findings of the full rotation is that Calcium is the nutrient that is expected to be limiting first when extrapolating nutrient budgets (Nykqvist, 1997). One first confirmation of this may be that Calcium concentration in leaves in the second rotation is halved compared with the first rotation at the same age (Comstedt, 2001). However, three years into the second rotation there is no sign yet of reduced productivity.

At the end of a four-month dry period in April 1998 (caused by the El Niño Southern Oscillation) the region was struck by large wildfires. The eleven catchments were affected by these fires. This provided an opportunity to observe the patterns of fire intensity and effect in different types of vegetation as the catchments at that time ranged from natural forest over young forest plantation to natural secondary vegetation and newly harvested plantation.

### **Deeper understanding of nutrient supply needed**

In the El Niño drought of 1998 the young *Acacias* showed undisturbed growth throughout the four month drought (Nordanstig, 1998). It was found that two year old *Acacia mangium* already had many fine roots down to, and into, the bedrock (Boström, 2000). Furthermore, mycorrhiza amounts per weight of fine roots were higher in deeper soil horizons than in topsoil. These are strong indications that nutrient input to forest plantations are indeed supplied from soil horizons not commonly included in traditional modelling of plantation nutrient budgets. This field of deeper understanding of below ground ecology and physiology of tropical forest plantations is very relevant to decreasing wood supply and land

management issues for the tropical region. A proposal for a PhD research project along these lines is currently under review by Sida (Sarec).

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### MANAGEMENT OF UPPER WATER CATCHMENTS - NEW RESEARCH SUPPORTED BY DFID

*By J R Palmer*

The Forestry Research Programme of the UK Department for International Development is commissioning a new cluster of projects on the management of upper water catchments. The projects respond to the need for research to improve the livelihoods of the sometimes very poor people in upper catchments, including marginalised farmers and minority ethnic groups. These rural communities may be culturally isolated from a country's main infrastructure and markets, as well as from educational and employment opportunities and national health care, even if they are not physically remote. Conventional development plans for upper catchments may fail to understand the cultural and economic value systems used by such communities; these systems may include important non-monetized and non-market benefits.

One project has started already, on the comparative performance of policy instruments for managing the demand for water in various forestry-related activities. This project is or will be operating in three countries: Grenada, South Africa and Tanzania. A particular focus in South Africa is the effect of removing invasive exotic tree species. The catchments had been planted during a time when an increase in timber supplies was thought to be more important than secure water supplies. This project is led by the Centre for Land Use and Water Resources Research (CLUWRR) at the University of Newcastle, UK, Email: [i.r.calder@newcastle.ac.uk](mailto:i.r.calder@newcastle.ac.uk)

The major hydrological study at the core of this research cluster will quantify the relationship between the area and spatial disposition of (forest) vegetation and dry season base flows of water. Research will begin in tropical montane cloud forest (TMCF), because this vegetation type has the unusual ability to add water to the natural rainfall by stripping moisture from clouds in the condensation zone. This work is starting at the well known research site of Monteverde in Costa Rica. Elevational transects will extend the studies to some other TMCF areas, and then to forest types at lower elevations and without cloud-stripping ability, and possibly into sub-tropical forests. This research will use newly developed process techniques to capture the quantitative relationship and so allow, for the first time, reliable predictions of the effects on water flows of changing land use. This research is a component of the IUCN cloud forest initiative, which involves also the International Hydrological Programme of UNESCO, the World Conservation Monitoring Centre, and WWF-International. The hydrological work is led by the Tropical

Environmental Hydrology Programme (TRENDY) in the Department for Hydrology at the Free University of Amsterdam, Email: [brul@geo.vu.nl](mailto:brul@geo.vu.nl)

If co-funding can be secured, a parallel study will research the effect on recharge and low flows of spatial changes in forest vegetation in dry climate catchments, in India, also involving CLUWRR, Email: [cluwrr@newcastle.ac.uk](mailto:cluwrr@newcastle.ac.uk)

Associated with the hydrological studies will be comparative research on methods for valuing forest goods and services, leading to decision support systems which recognise the existence of different cultural concepts of value. A guide will be produced on the choice an application of forest valuation methods. The intention is to help negotiations over land use and forest changes become more equitable, by providing a common platform of shared information and value concepts.

Experimental work will be undertaken on the development of water markets and downstream-upstream compensation mechanisms in small- and medium-sized catchments; this experimental work will complement the documentation of a range of water market systems which will be undertaken by the Forestry and Land Use Programme of the International Institute for Environment and Development, London, UK, Email: [natasha.landell-mills@iied.org](mailto:natasha.landell-mills@iied.org). Upstream managers of lands and forests could then negotiate with downstream water users and consumers over the price or other benefits to be secured for ensuring particular water flows in particular seasons.

The research on decision support systems for valuation, and later work on mechanisms

to capture the agreed values, will aid another cluster of projects beginning this year (2001) on forest yield regulation in developing countries. This cluster is being led initially by the Institute for Ecology and Resource Management (IERM) at the University of Edinburgh, U.K. Email: p.vangarding@ed.ac.uk

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### **WATER CATCHMENT RESEARCH. ISSUES AND OPTIONS FOR DFID'S FORESTRY RESEARCH PROGRAMME**

*By Kirsti Thornber*

As part of planning towards a new research cluster on management of water catchments, the Forestry Research Programme (FRP) held two workshops in December 2000 to discuss issues and options for research, one focused on hydrological issues, the second on socio-economic issues. This summary highlights concerns raised in the workshops. Further information can be gained from the author.

#### **Key questions from workshops.**

#### ***Why is further hydrological research necessary?***

Past hydrological research has provided only catchment-specific, unreplicable results. Many unproven assumptions about cause-and-effect linkages regarding land-use and water remain. This has misguided land-use decisions in many places. To allow improved decision-making, unambiguous and defensible information is needed. New developments in hydrological research allow a process approach, from which models can be derived, calibrated and applied in other areas.

#### ***Why focus research in tropical montane cloud forest (TMCF) watersheds, when the number of people dependent on TMCF is low, relative to other forest/vegetation types?***

The water production value of TMCF is high - it captures 5-100% more water than the total rainfall, through interception of cloud moisture. Removals of TMCF or lower montane buffer forests can have significant, attributable effects on both base level and dry season water flows downstream. Enormous downstream populations are dependent on TMCF, as well as those who live in or near it. New hydrological research approaches are expected to be able to produce definitive, quantitative relationships between TMCF cover changes and dry season flows. This cause-effect relationship is less clearly quantifiable for other forest types.

The high biodiversity of TMCF provides a range of livelihood services to poor local people, including non-timber forest products and cultural values, but it is being deforested at a greater rate than other forest types. Conservation efforts need to be informed by reliable information on impacts of potential land-use change.

### ***Why focus the hydrological research only on dry season flows?***

The definitive attribution of effects of TMCF removal on dry season and base water flows possible through new approaches to hydrological research (noted above) may not yet be possible for other aspects of water service provision (such as erosion or sedimentation).

The additional water captured by TMCF is especially critical in areas with a marked dry season without rainfall, when the water stripped from clouds is the only addition to the watershed during the dry season.

### ***When and how might the research from TMCF be extendable to other forest/vegetation types and other regions?***

FRP's proposed hydrological research involves using the new developments to derive and calibrate models for use in other areas. It includes study of hydrological processes in various forest types along the elevational gradient. This approach aims to track the changes in reliability of quantified vegetational-hydrological relationships from TMCF to other forest types, where the relationships are more difficult to display unambiguously. It is anticipated that this definitive, reliable set of results will provide critical lessons for use with other forest types and water service issues.

### ***Why focus hydrological research in sites where good hydrological research can happen, when these are not areas of socio-economic need?***

To be able to produce definitive, quantitative relationships between forest cover changes and dry season flows, research needs to be carried out in areas where there is already good data on which to build. In data-poor areas, research will not produce as reliable

results. Socio-economic work can be done in these and/or non-cloud forest areas.

### ***Will the hydrological studies interface/link with the socio-economic work?***

Studies in this cluster will be carried out by multi-disciplinary teams, including socio-economists. The workshops agreed that establishing a standardised approach to characterising stakeholders in different catchments would be valuable to all research and development projects in upper catchments. Sharing experiences through action learning as work progresses will ensure that approaches in different research projects are compatible for ease of promotion of results in broad recommendation domains away from the specific research areas.

### ***What is the likelihood that research will lead to development of a decision support system (DSS) that will actually break down the 'myths' of land-use effects on water, and influence land-user behaviour?***

It is difficult to assure a change in the behaviour of land-users, or policy-makers. Promotion of sustainable and equitable changes in attitude and policy requires negotiation to be supported by unambiguous information about the real hydrological links between land-use and water. Diverse views about the values of forest goods and services amongst the stakeholders can then have some common ground.

The hydrological work will feed into the DSS developments. Communication between all researchers is essential to take efficiently the science into social and political reality. Close links into ongoing efforts to develop and establish appropriate markets are key.

The DSS should emerge from and feed into negotiation processes. It should channel information to different categories of

stakeholder, in culturally appropriate ways, with the communication methods and the information being based on different stakeholder perceptions about values and choices. Involving stakeholders in the development of the DSS should ensure its effectiveness.

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### THE HELP-INITIATIVE TO CO-ORDINATE CATCHMENT RESEARCH

***Given the strength of power politics in negotiations about water services markets and pricing, can the information provided by the research really make a difference?***

Whilst decision-making may be improved by inclusive negotiations, imbalances in negotiating power will persist. Thus livelihoods of the poor cannot be expected to be improved without equitable access to reliable, factual information, that does not disfavour the poor; mutual understanding of social and cultural positions and beliefs.

Feeding that information into the negotiation processes in a targeted way to the less powerful stakeholders, and supporting the negotiating process with a range of DSSs, will begin to address power imbalances.

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Hydrology for the Environment, Life and Policy (HELP) is a new initiative to establish a global network of catchments to improve the links between hydrology and the needs of society. The vital importance of water in sustaining human and environmental health has been widely recognised by numerous national and international fora. However, no international hydrological programme has before addressed key water resource management issues in the field and integrated them with policy and management needs.

In response to these concerns, United Nations agencies have for more than four decades been encouraging the collection and analysis of hydrological data, and capacity building. All their most recent assessments support the urgent need for action to address global water management issues. For example, the UN Commission on Sustainable Development (CSD) emphasised the emerging issue of global water scarcity, partly in response to the recommendations of the Rio Conference and Agenda 21. In 1994 the CSD called for "a comprehensive assessment of freshwater resources, with the aim of identifying the availability of such resources, making projections of future needs, and problems to be considered". Three years later, the "Comprehensive Assessment of the Freshwater Resources of the World" was presented to CSD 5 and the

UN General Assembly Special Session (UNGASS). This document was prepared by a steering committee comprising all UN agencies involved in fresh water, and in co-operation with the Stockholm Environment Institute. A further important step towards realising the CSD objective is the publication of the UNESCO-IHP monograph "World Water Resources".

The European Commission has examined water issues across Europe (Freshwater: a challenge for innovation, 1998). This widely consulted document highlights water as a strategic resource, and recognises that - even in areas with high precipitation and in major river basins, over-use and mismanagement of water resources have created severe constraints on supply. Such problems are widespread and will be made more acute by the growing demand on freshwater arising from increasing economic development.

There remains the traditional separation between the water policy, water resource management and scientific communities, especially in terms of setting of research agenda and free-flow of information for use in management. A result is that there is a significant time lag in the implementation of scientific outputs to the benefit of society. In addition, water management policy is globally based on outdated knowledge and technology. In many cases, procedures are followed with scientists not grasping what is required and stakeholders unaware of what alternatives are available. This "Paradigm Lock" has come about because the two main groups have become isolated: scientists by the lack of proven utility of their findings and stakeholders by legal and professional precedence and disaggregated institutions.

The background to HELP can be traced back to the first International Hydrology Decade (IHD). This ran from 1965 to 1974 and was established in response to the need for the systematic study of the hydrological environment. This was very successful and led to a series of follow-up programmes including the successive phases of the International Hydrology Programme (IHP) of UNESCO. To date there have been five phases of the IHP, and the sixth is currently being planned to run from 2002 to 2007.

The idea that there should be a new international initiative similar in scope to the IHD emerged in 1996 at the United Nations Administrative Committee on Co-ordination Sub-Committee on Water Resources (UN ACC SWR) 17th Session (Paris, October 1996) which recommended that there should be a Global Water Quality Initiative. Meanwhile, individuals and groups of scientists independently recognised a similar need and calls were made for a science-driven 2nd International Decade. These were followed by approaches from members of the GEWEX community who proposed consideration of a second IHD by UNESCO.

In response to the above requests, UNESCO and WMO co-sponsored a meeting of an informal expert group (held at Wallingford, UK, in December 1998), which recommended the development of a new international hydrology initiative. The conceptual framework of this initiative was to combine experimental hydrology with water resource management and policy issues. This concept was presented at the 5th Joint UNESCO/WMO Conference on International Hydrology (Geneva, February 1999) where it was unanimously endorsed. The conference recommended the creation of a new global initiative, which would, through the

establishment of a global network of catchments, in which the scientific agenda will be set behind the most critical water policy and water management issues. This new initiative is entitled HELP (Hydrology for the Environment, Life and Policy). The conference recommended the establishment of a task force, consisting of hydrological scientists, water resources managers and water policy and law specialists, to develop the concept further. The structure of the resultant Task Force and its Terms of Reference are shown in Appendices I and II. The conference also requested the preparation of this project document by the task force.

HELP was approved by the 28th Session of the IHP Bureau, which recommended that HELP, like FRIEND, should become a distinctive cross-cutting programme of the UNESCO IHP. The Bureau also recommended that HELP should develop strong links with appropriate parts of other global programmes such as the WMO/WCRP, ICSU/IGBP, other UN agencies, non-governmental organisations, international programmes and the World Water Council's Vision on Water, Life and Environment in the 21st Century (Appendix III). To this end, these communities were invited to send representatives and participate in the first HELP task force meeting in Arizona (20-26 November 1999).

This text was extracted from the HELP website at: <http://www.nwl.ac.uk/ih/help/>. More information on current activities are available on the website or from Dr Mike Bonell, UNESCO, 7place de Fontenoy, 75352 Paris 07 SP, France

### **MANGROVE RESEARCH AT THE VRIJE UNIVERSITEIT BRUSSEL**

#### **Mission**

The Mangrove Management Group is an informally organized and open collaboration between various scientists of the Vrije Universiteit Brussel (VUB), intending to combine their diverse fields of expertise (chemistry, botany, zoology, socio-economy, remote sensing) as applied to the mangrove ecosystem in its widest sense. It is expected and it was experienced that this diverse input is scientifically very enriching for all partners and that it allows to tackle a wider range of problems. Though there is a general interest in fundamental questions (and answers), the Mangrove Management Group is very much aware of the fact that research into this complex ecosystem can rarely or never take place without taking into account its vital role for human society, particularly for people relying directly on mangrove resources. It is also realized that this is more commonly the case for developing countries. It is a principle that wherever and whenever possible scientists or other people who can contribute from the host country be involved and/or receive feedback about results.

**The general mission of the Mangrove Management Group is to contribute scientifically to a better understanding of the mangrove ecosystem and to yield elements to improve mangrove management and conservation.**

#### **Research framework**

The research framework presented here includes different aspects within the theme of mangrove vegetation structure dynamics,



regeneration and restoration (*cf.* Dahdouh-Guebas, 2001; Kairo, in prep.). In addition to these studies there is also a heavy emphasis on the trophic relationships within mangroves and between mangroves and near-shore ecosystems (Laboratory of Analytical Chemistry). Below a general overview of the depicted research framework will be given (numbers refer to the research framework in the figure).

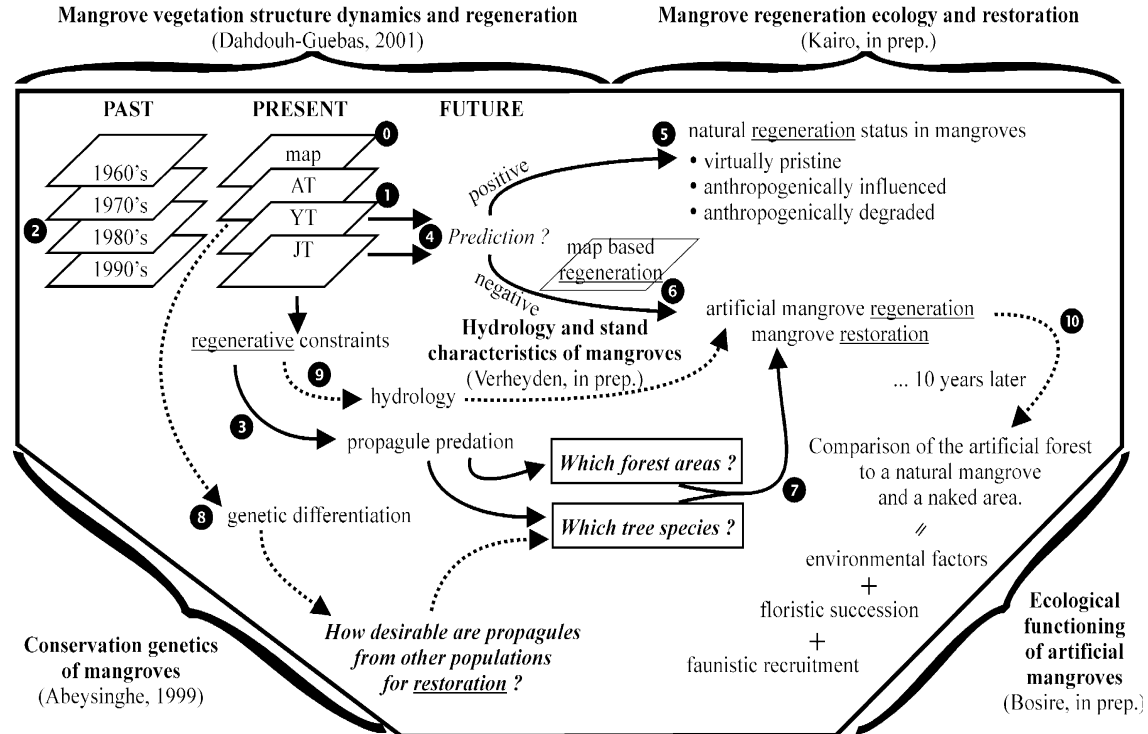
This framework starts with the mapping of the present vegetation structure through airborne remote sensing (0). Fieldwork in which we assess the horizontal and vertical distribution of adult, young and juvenile trees completes the analysis of the vegetation structure at present (1). Retrospective investigation of the same area is done through sequential aerial photography from the past (2). The juvenile vegetation layer is subject to regenerative constraints, of which propagule predation is investigated in-depth (3). In combination with the evolution in the recent past of the mangrove and the present distribution of adult trees, both the young and the juvenile vegetation layer can be used to make a prediction for the future, which can be either positive or negative with respect to the extent or composition of the mangrove (4). In case of a positive prediction we are interested in the assessment of the natural regeneration potential and make a comparative study between mangrove forests with various degrees of disturbance (5). In case of a negative prediction artificial regeneration and restoration may be necessary (6). Two questions must be addressed then : first, which forest areas need rehabilitation, and second, which tree species are going to be

used to rehabilitate those areas ? (7) The study on propagule predation contributes to the answer on both questions. The links with other research frameworks is given in dotted lines. The study of the genetic differentiation in the adult trees of various mangrove populations partly provides elements to answer the question of desirability of propagules from other populations for restoration (Abeyasinghe, 1999) (8). The investigation of hydrology in general or as a regenerative constraint in particular provides information to the rehabilitation of mangroves (Verheyden, in prep.) (9). Questions that have often been forgotten in rehabilitation programmes are designed a separate framework (Bosire, 1999, in prep.) : “What happens with the artificial regeneration plots 10 years from now ?”, “How functional in the ecological sense do these plantations become ?” and “Is there faunal and floral recruitment into the often monospecific plots ?”. Therefore we compare the artificial forest with a natural mangrove and a naked area and investigate the environmental factors, the floristic succession and the faunistic recruitment (10).

### Results

The research presented above is on-going and the findings generated so far have been published in peer-reviewed manuscripts, theses and websites. Particularly via the internet the interested audience is invited to browse through the results of different research aspects and to contact us for reprints or further information (see URL below).

## Research framework



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### IMPACTS OF SEDIMENTATION ON MANGROVE DYNAMICS ALONG THAI COASTLINES

*By Udomluck Thampanya & Jan Vermaat*

In South East Asia, sediment loads to coastal waters have increased over the past decades, leading to a well-quantified decline in area and cover of seagrass and reef coral habitats. Causes for this increased loading are linked to overexploitation of terrestrial watersheds. The effect of such increased sedimentation on mangroves, however, is less well studied and a priori less straightforward: since mangroves inhabit muddy sediment deposition shores, they may even respond positively. Generally, however, mangrove forest area has declined dramatically all over SE Asia due to over exploitation and conversion to shrimp ponds. Presently, widespread attempts to reafforest

mangroves meet with variable success. In this study we assessed:

- Whether mangroves indeed progressively colonize newly accreting shores along peninsular Thailand, combining remote sensing and in situ age reconstruction along transects.
- Whether sediment burial would affect survival and growth of three common SE Asian species: *Avicennia alba*, *Rhizophora mucronata* and *Sonneratia caseolaris*.
- For the same three species, whether different exposure to water motion would affect survival and growth along transects in Pak Phanang Bay (S Thailand).
- Whether the combination of these data would allow the construction of a predictive model of mangrove propagule recruitment success.

The project is in its final stage, and we report a few highlights here from studies 2 and 3. In a randomized block design, sediment burial (0-32 cm) caused substantial mortality in *Avicennia alba* and *Sonneratia caseolaris*, but not in *Rhizophora mucronata*, probably due to the much taller hypocotyl of the latter species, raising its viviparous seedling far above the experimentally increased sediment surface. Exposure to waves and currents was found to have a strong seasonal component, having maximal values during the high river discharges of the monsoon season. Survival of the seedlings of *Avicennia alba*, *Rhizophora mucronata* and *Sonneratia caseolaris* differed strongly across the steep spatial gradients from the open mudflat into the mangrove forest and

less between sites of different exposure across the Bay. Over the whole one year lasting experiment, the smaller seedlings of *Avicennia alba* and *Sonneratia caseolaris* showed higher mortality than the larger ones of *Rhizophora mucronata*. Seedlings of the latter species, however, are produced in much smaller quantities, and survive substantially better in the area of some existing vegetation. For the other two species, the pattern was opposite: seedlings survived better on the open mudflat. This confirms the successional status of the three species: *Avicennia alba* and *Sonneratia caseolaris* being early colonizers, and *Rhizophora mucronata* establishing at a later stage.

We suggest that a strategy for successful re-establishment of mangrove stands would be to allow natural colonization by early successional species. Presently, this is frequently hampered by intensive fishing activities with push nets and trawls. Establishment of enclosures in potential area would probably be profitable.

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### THE CONTRIBUTION OF FLOODING-TOLERANT LEGUME SYMBIOSES TO THE N-CYCLE OF THE PANTANAL MATO-GROSSE WETLANDS OF BRAZIL

*By Euan K. James\*, Janet I. Sprent and Richard Parsons*

The Pantanal Mato-Grossense is located in the west of Brazil and to the south of Amazonia and has a total area of 138,183 km<sup>2</sup>, excluding the approximately 10% of its area that lies in neighbouring Bolivia and Paraguay. It is the largest pristine wetland in the world and is of extreme importance in South America, both ecologically, due to its biodiversity, and economically, as a source of tourism, fresh water, fish, wildlife, forage and timber plants. However, as with other tropical wetlands, this little-studied and fragile region is increasingly under threat from drainage and/or dyke-building for agriculture and housing, deforestation, and pollution. In the northern part of the Pantanal, south of Cuiabá (the capital of the state of Mato Grosso), the unique flora is particularly threatened by drainage and dyke-building for cattle ranching, as well as from overgrazing.

Tropical wetlands, such as the Pantanal, the Amazon region and the Orinoco basin generally experience two types of flooding, each associated with a unique flora. Plants in the central regions close to the water courses are more or less permanently flooded, whereas those in the peripheries are subjected to seasonal flooding. In both cases, many of the plants are nodulated legumes, and recent work has shown that not only can these fix N<sub>2</sub> whilst flooded, but there may even be positive selection pressure for them to do so. This selection

pressure may be due to the inherently low N-status of the heavily leached soils brought about by seasonal flooding, and also because, under more permanently-flooded conditions, there is a decrease in the mineralisation of organic matter and an increase in denitrification, all of which result in a shortage of available N. Moreover, and specifically in the case of the Pantanal, the headwaters of the rivers that feed it (Rio Cuiabá, Rio Paraguai) can be low in organic and inorganic nutrients. This lack of external input of nutrients exacerbates the scarcity of N in the wetland during the flooded period, and hence increases the demand for biological N<sub>2</sub> fixation. The predominant source of fixed N in the Pantanal is almost certainly from nodulated legumes, as they have already been shown to contribute significantly to the N-balance of other tropical wetlands and rainforests, such as the Amazon region, French Guiana, and the flooded forests of the Orinoco basin, and are considered to be the main contributors of fixed N in all pristine ecosystems.

There has been comparatively little research on tropical wetland legumes. Not all of them have been checked for an ability to nodulate: a study of nodulation in 172 legume species in the Amazon region of Brazil found that 56% of the reports of nodulation were new, with most of the nodulated legumes being found within the seasonally-flooded *Varzea* and *Igapo* areas rather than in the drier *Terra firme* regions. The legumes of the Pantanal have been studied even less than those in the Amazon. However, the Pantanal has recently been the source of a number of new discoveries of flooding-tolerant legume symbioses, including a new genus of stem-nodulating shrubs, *Discolobium*, and a new report of stem nodulation by a species of *Aeschynomene* (*A. fluminensis*). A recent

field study from our laboratory which was conducted in collaboration with Brazilian researchers (Fatima Loureiro, UFMT, Cuiabá, Arnildo Pott, Vali Pott, Embrapa-Pantanal, Corumbá, and Avelio Franco, Claudia Martins, Embrapa-Agrobiologia, Rio de Janeiro) has confirmed that not only are these legumes abundant in the Pantanal, even in the central, permanently flooded, regions, but also that they are extensively nodulated and hence may have substantial rates of N<sub>2</sub> fixation. See Table.

### *Potential importance of flooding-tolerant legumes to the ecology of the Pantanal*

Our initial studies have shown that the type of legume symbiosis may differ according to the flooding regime and that there are adaptations to two types of flooding: permanent and seasonal. The former is best exemplified by *Discolobium pulchellum*, whose stem nodules cannot form or function without being surrounded by water or wet soil, and the latter by various *Aeschynomene* spp. on which stem nodules form during the flooding period and remain functional after the flooding recedes. There are also a number of semi-aquatic legumes, such as *Mimosa pellita* and *Neptunia plena* that are rooted in mud at the peripheries of the river channels and permanently-flooded baias. These are not stem-nodulated, but instead have their nodules on adventitious roots that form on their flooded stems. Finally, in the permanently flooded regions of the Pantanal there is a great abundance of legumes that are not actually "flooding tolerant" as such, but have a floating habit that prevents their

nodules (borne on stems and/or adventitious roots) from being substantially submerged. Good examples are *Neptunia prostrata*, *Sesbania exasperata* and *Vigna lasiocarpa*.

Nodulated legumes are potentially of great importance to the ecology of the Pantanal. In addition to their N<sub>2</sub>-fixing ability, those listed in Table 1 are very palatable and readily foraged by indigenous fauna and/or cattle. This is especially true of the *Aeschynomene* and the *Discolobium* spp., whose submerged stems are eaten by the herbivorous fish pacu (*Piaractus mesopotamicus*) and by the giant rodent capybara (*Hydrochaeris hydrochaeris*). The indigenous people of the Pantanal also use *Aeschynomene* and *Discolobium* spp. for medicinal purposes. Owing to their ability to fix N<sub>2</sub> and to tolerate flooding, *A. fluminensis*, *A. sensitiva* and *S. exasperata* are showing promise outside the Pantanal as pioneer species for recovery of flooded ponds filled with residues of bauxite minings in regions such as Porto Trombetas in the Amazon. However, in order to fully characterise the ecological role of nodulated legumes to the biology of the Pantanal and other tropical wetlands, it will be necessary to quantify their populations in regions with different flooding regimes. In addition, <sup>15</sup>N natural abundance studies, such as those that have been undertaken in the Amazon floodplain and in the rainforests of French Guiana, are urgently needed in order to assess the potential contribution of nodulated legumes to the N-budget of this largely oligotrophic region.

## Organisations - Institutions - Programmes

| Species                                                  | Authority                   | Nodules                  | Comments <sup>a</sup> |
|----------------------------------------------------------|-----------------------------|--------------------------|-----------------------|
| <i>Aeschynomene ciliata</i>                              | Vog.                        | Stem                     | Dry                   |
| <i>Aeschynomene denticulata</i>                          | Rudd                        | Stem                     | Flooded               |
| <i>Aeschynomene fluminensis</i>                          | Vell.                       | Stem, Root               | Dry, Flooded          |
| <i>Aeschynomene sensitiva</i>                            | Sw.                         | Root                     | Dry                   |
| <i>Discolobium leptophyllum</i>                          | Benth.                      | Stem, Root               | Flooded               |
| <i>Discolobium pulchellum</i>                            | Benth.                      | Stem, Root               | Flooded               |
| <i>Mimosa pellita</i>                                    | H.B. ex Willd.              | Root                     | Flooded               |
| <i>Mimosa polycarpa</i>                                  | Kunth                       | Root                     | Flooded               |
| <i>Neptunia plena</i>                                    | Benth.                      | Root                     | Flooded               |
| <i>Neptunia prostrata</i>                                | (Lam.) Baill.               | Stem <sup>b</sup> , Root | Flooded               |
| <i>Neptunia pubescens</i>                                | Benth.                      | Root                     | Dry                   |
| <i>Sesbania exasperata</i>                               | H.B.K.                      | Stem, Root               | Flooded               |
| <i>Vigna lasiocarpa</i> (syn. <i>Phaseolus pilosus</i> ) | (Benth.) Verdc.<br>(H.B.K.) | Stem, Root               | Flooded               |

<sup>a</sup> Flooded = plants partially submerged in water or rooted in saturated soil.

<sup>b</sup> Nodules on floating stems but attached vasculary to the bases of subtending adventitious roots.

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### **GASEOUS NITROGEN TURNOVER IN THE AMAZON FLOODPLAIN FOREST**

*by Heidi Kreibich*

In Central Amazonia the average flood amplitude of the Amazon river is 10 m, which leads to predictable floods in the middle of the year. Due to the annual water and nutrient input, the Amazon floodplain (várzea) is characterised by many unique adaptations of plants and animals, a high biomass production and a rapid nutrient turnover. Small scale agriculture and shifting cultivation has been practised for centuries, but with accelerating population growth and commercial interest pressure increases and is already clearly visible.

National and international efforts are urgently needed to preserve this unique ecosystem and to prevent further uncontrolled deforestation. The German-Brazilian SHIFT project: "Gaseous Nitrogen Turnover in Amazon Floodplain Forest" studies the complex nutrient cycles within the floodplain forest to provide essential knowledge for the development of small

scale, sustainable and suitable management concepts.

Nitrogen is one of the most important macro nutrients but the significance of specific nitrogen sources and sinks is only rudimentarily known. Therefore N<sub>2</sub> fixation and denitrification were monitored in the floodplain forest over one entire annual hydrological cycle to identify their role for nitrogen availability in the várzea.

Due to rhizobium symbioses legumes have a high potential for biological nitrogen fixation. They are valuable plants for agriculture and also on the Amazon floodplain they may play an important role for the ecosystem. Within the várzea forest there are about 20% leguminous trees. It could be shown that nodulated legume trees may fix nitrogen derived from atmosphere (Ndfa) at high amounts. Estimations using the isotopic ratios in leaves resulted in mean values of 32% Ndfa for *Pterocarpus amazonum*, 37% Ndfa for *Albizia multiflora* and 60% Ndfa for *Zygia inaequalis*. In comparison nitrogen fixation is only slightly higher in agricultural crops (soybean 50% Ndfa, pea 70% Ndfa, clover 90%).

On the other hand denitrification might be a key process in the várzea, since the gaseous nitrogen turnover in the soil is considerably influenced and stimulated by the flood pulse. More than 80% of the nitrogen loss via denitrification occurred during the aquatic phase, with highest activities during flooding and the transition periods. The soil water content has a large influence on the availability of oxygen in soil, and consequently on anoxic processes such as denitrification. Although denitrification could be measured in the soil even at a depth of three meters, maximum activity occurred in



the litter.

Further within this project nitrogen fixation and denitrification will be balanced for one particular forest area to estimate their importance for the whole nitrogen cycle of the várzea forest. In the future the results may be used for the implementation of agroforestry systems in the várzea. Supporting the cultivation of legumes may open new perspectives for sustainable management by improving soil fertility, reducing erosion and transferring the fertilising effects to associated crops.

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### **IMPACT OF EUCALYPT PLANTATIONS IN CONGO ON THE CHEMICAL COMPOSITION OF SURFACE WATERS**

*By Jean-Paul Laclau*

In Congo, *Eucalyptus* species were introduced in the littoral savannas in the early fifties. Highly productive varieties of 2 hybrids were developed since that time and 42000 ha of clonal plantations have been set up around Pointe-Noire to produce pulpwood. The sustainability of the management of these plantations, i.e. long-term production and maintenance of the environment, was identified as a priority for research. This question is particularly

relevant as high amounts of nutrients are exported every 7 years with biomass removal, in sandy and acidic soils with low reserves of available nutrients.

The biogeochemical cycles of nutrients were studied in 2 stands located side by side in the Kouilou region, near Pointe-Noire : a clonal eucalypt plantation and a native savanna. The plantation was between six to nine years old at study. The objectives were (i) to improve our understanding of the mineral functioning of both ecosystems, (ii) to establish input-output budgets in order to quantify the impact of the plantation management on the nutrient capital in the soil and (iii) to assess the environmental impact of the eucalypts on the chemical composition of surface waters.

In particular the changes in precipitation chemistry during the transfer of solutions in both ecosystems was studied. Special care was taken to identify the processes contributing to the chemical composition of the solutions. During the rainy and the dry seasons, rainfall was on average 151 mm and 7 mm per month respectively. Chemical analyses performed monthly during 3 years showed that the concentration of all the elements in rainfall increased sharply during the dry season. Precipitation solutions were acidic ( $\text{pH} < 4.5$ ) with a dominance of  $\text{Na}^+$ ,  $\text{Ca}^{2+}$  and  $\text{Cl}^-$ . Throughfall and stemflow were enriched for most of the elements but a N foliar uptake was observed in both stands.

The concentration of the majority of elements increased during the transfer of the solutions through the litter layer. This enrichment was particularly marked for  $\text{H}^+$  and dissolved organic carbon in both stands. A severe water repellency observed at the surface of the soil in the eucalypt stand increased the

time of contact between the solution and the forest floor and a net uptake of  $\text{Ca}^{2+}$  by a dense root mat inside the forest floor was observed. In the savanna, a net uptake of  $\text{N-NH}_4^+$ ,  $\text{K}^+$  and  $\text{Mg}^{2+}$  was also measured in the surface soil. At the depths of 15 cm and 50 cm, the gravitational soil solutions were collected by 4 replicates of zero tension plate lysimeters (ZTL) in each stand. The "capillary solutions" were collected by 4 replicates of ceramic cups connected to a suction of -600 hPa, at the depths of 15 cm, 40 cm, 1 m, 2 m, 3 m and 4 m in each stand plus at the depth of 6 m in the eucalypt stand.

At the depth of 15 cm, the concentration of most elements in the solutions collected by ceramic cups was lower than in the gravitational solutions. This result was unexpected because solutions collected by tension lysimeters are usually enriched by weathering processes and by the activity of micro-organisms. With a suction of -600 hPa, solutions collected by ceramic cups included both gravitational solutions and solutions from smaller pores, in equilibrium with the soil and the vegetation. In this ferralic arenosol, the release of base cations by weathering is expected to be low. Also, the availability of exchangeable cations was weak and the very low concentrations of  $\text{N-NO}_3^-$ ,  $\text{N-NH}_4^+$  and base cations measured in solutions collected by ceramic cups showed a very efficient uptake by the vegetation. A very dense network of thin roots in the upper layer of soil was observed in both stands, allowing a very quick uptake of nutrients. In deeper layers the concentrations of all the elements were very low in the "capillary solutions", except for Si and dissolved

organic carbon.

A hydrological model of water transfer in both ecosystems was developed to predict the fluxes of gravitational water at various depths in the soil. A validation of this model was made from a TDR monitoring of soil water content during 2 years, with 3-5 replicates of probes at the depths of 15, 50, 100, 200, 300, 400 and 500 cm in the soil. The concentrations of solutions collected by ceramic cups were used to calculate the losses of nutrients by deep drainage because gravitational solutions were not collected in the deep layers of soil. It was however checked that the intensity of the suction applied did not significantly change the chemical composition of the solutions collected.

The results of this study showed a very efficient uptake of the nutrients by both stands and very low losses by deep drainage in this ferralic arenosol soil. The quality of drainage water was similar beneath both ecosystems, with extremely low concentrations of all the mineral elements.

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### NUTRIENT CYCLING

*By C. Tobón Marin*

A comprehensive hydrological and nutrient cycling research was carried out in four undisturbed forest ecosystems in Colombian Amazonia, through the monitoring of variables and modelling. These forests differ in their structure and soil conditions and are located on a similar number of landscape units (Tertiary sedimentary plain, high and low terrace and the flood plain of the river Caquetá). The main objective of the research was the characterisation of the hydrology and nutrient cycling, by describing and quantifying the temporal and spatial dynamics of the hydrological and nutrient fluxes through the forest compartments. During a five year period data on climate was collected on twenty minutes basis and daily measurements of gross rainfall, throughfall, stemflow, forest floor water content, litterflow, soil water pressure head, soil water content, basin drainage, atmospheric nutrient inputs, internal fluxes and output were carried out. Additionally, some forest characteristics, forest structure, litter structure and soil properties were characterised. For this study a compartment approach was followed, which provided specific information on the water and nutrient fluxes between and in each compartment.

Results indicated that the percentage of throughfall depended on the amounts and characteristics of gross rainfall and on forest structure (forest cover and LAI). Throughfall percentage ranged from 82 to 87% of gross rainfall in the studied ecosystems and varies linearly with rainfall quantity. Stemflow contributes little to net precipitation (1.1% of

gross rainfall) and shows a power relation with gross rainfall. Evaporation during rainfall has a linear relation with rainfall duration and the ratio between evaporation and gross rainfall increases with forest cover in the ecosystems studied. The presence of a thick litter layer or forest floor (FF), and the concentration of fine roots in this compartment determine the net rainfall partitioning into uptake and drainage to the mineral soil. Drainage from the FF varied between ecosystems, ranging from 87% to 93% of net rainfall. Results pointed to differences between ecosystems in the FF water storage capacity, water content and water uptake amounts. The FF in the sedimentary plain stored the highest amount of water and the water uptake was also the highest, accounting for about 30% of total forest water uptake during the period studied. The FF in the flood plain retained the lowest with the lowest uptake.

The water retention characteristics and field measurements pointed to a low water availability in the Amazonian soils studied, although soil water storage was high and almost constant during the studied period, except during the droughts. Water content dynamics in the upper soil layers was more variable than in deeper layers, which is connected to soil properties and root uptake. For the upper part of the soil profiles, a water flux model predicted high flux rates upon inputs, which is in line with the high macro and mesoporosity and well developed structure.

The rainfall distribution and the high water storage of soils are the most important factors in the maintenance of actual transpiration at almost potential rate during most of the year except for the short dry periods when actual transpiration decreased

to almost one third of the reference. The FF together with the upper soil layers, where fine roots are concentrated, are responsible for the supply of most of the water demand by these forests. The annual water balances during the studied period showed that the fraction of intercepted rainfall differs between ecosystems, being the highest in the flood plain. It showed that differences between ecosystems in the magnitude of water fluxes through the forest compartments are mainly due to differences in forest structure, forest floor thickness, soil properties and fine root distribution. Within the range of ecosystems studied, the largest differences in hydrological behaviour and water fluxes at compartment level were observed between the forest on the sedimentary plain and the flood plain.

### Nutrient fluxes

Results from the nutrient cycling study indicated that in this part of the Amazonia solute inputs in gross rainfall are very low, Na and  $\text{SO}_4$  being the elements with the highest concentration in rainfall and there are no significant differences in rainfall composition among studied landscape units. The high temporal variability found for the solute fluxes depended on temporal rainfall patterns with almost no influence of the preceding long lasting dry period. The main nutrient source of rainfall chemistry was the combination of biomass burning and natural biogenetic emissions; followed by the marine source, which mainly explain the presence of Na, Cl and Mg. A third factor seem to be exclusively source from plant emissions and a weak source of acidity.

Nutrient concentration in rainfall increased considerably after water passed the forest canopies with higher values in the flood plain

and low terrace than in the high terrace and sedimentary plain. Trends of ion enrichment vary among the forests; however there is a general tendency in all ecosystems for a higher enrichment of  $\text{SO}_4$ , K, Cl,  $\text{NO}_3$  and  $\text{NH}_4$  in throughfall and stemflow and a low or negative increase of protons, Mn, orthoP and Fe. Throughfall is the most important transport media of solutes to the forest floor, which contributed with 98% of total solute inputs. Nutrient enrichment in throughfall and stemflow were mostly related to the long-lasting dry period before a sampling date followed by the amounts of throughfall and stemflow. Moreover the increases of frugivores in the forests seem to influence the increasing ion concentrations in throughfall and stemflow during the fruiting periods. The main source of solutes in throughfall and stemflow appeared to be the washoff of exudes, deposited ions in the foliage after evaporation of intercepted rainfall and dry deposited materials.

After throughfall and stemflow passed the FF, the concentration of some ions decreased relative to that in throughfall in most of the events in studied forests. Nevertheless, most nutrients increased their concentration in the whole, except for orthoP, which was influenced by the amounts of nutrients released by litter decomposition. Concentrations of ions in litterflow followed a similar pattern as those in throughfall, indicating that ion inputs to the FF largely originate from the throughfall and stemflow. Litterflow ion concentration showed a poor correlation with variables as litterflow amounts, rainfall intensity and preceding dry period. Amounts of nutrients fluxing out to the mineral soil were significantly different between forests ( $P < 0.05$ ), these fluxes being larger in the sedimentary plain and in the high terrace, mainly for ions as  $\text{SO}_4$ ,

NO<sub>3</sub>, Cl, K and Na. The FF nutrient balance indicated that these FF's act as a sink for nutrients incoming in throughfall, stemflow and litterfall, where orthoP and Mg appeared to be the most limiting elements. Finally the basin discharge of nutrients showed to be in balance with inputs, with large outputs during the high intensity rainfall events. The hydrographs indicated that most outputs of nutrients occur at the end of the events, mainly of elements as Si, SO<sub>4</sub> and protons.

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### **ECOLOGICAL WATER QUALITY : A VALUABLE TOOL TO ASSESS THE IMPACT OF LOGGING ACTIVITIES ON TROPICAL FORESTS ?**

Pascale Derleth<sup>1</sup>, Rodolphe Schlaepfer<sup>1</sup>, Michel Sartori<sup>2</sup> and Jean-Luc Gattolliat<sup>2</sup>

This Ph D study is supervised by the EPFL<sup>1</sup> (Swiss Federal Institute of Technology), Lausanne, Switzerland in collaboration with CIFOR (Centre for International Forestry Research), Bogor, Indonesia and the Museum of Zoology<sup>2</sup> in Lausanne, Switzerland. The research is sponsored by ZIL (Swiss Centre for International Agriculture), Zürich, Switzerland.

#### **Project summary**

There is widespread agreement throughout the world that methods to assess

sustainable use of tropical forest are needed. One possible approach is to define Criteria and Indicators of sustainable forest management. The present communication presents some preliminary results on the first step of a three year project named: "An evaluation of sets of indicators and verifiers to assess the biodiversity of tropical forests: landscape and water quality indicators".

This study takes place in East Kalimantan Province in Borneo (Indonesia) where the main use of the forest remains logging activities. As potential indicator for sustainable use of forest we chose to study water quality measured by macroinvertebrates and physical parameters. In other words, we study the relationship between the logging activities and forest biodiversity through the ecological quality of the streams. The study is undertaken at both local (species/ecosystem/habitat) and landscape levels.

**The study area**, covering 8500 ha, is located 116°30'E and 3°00'N in a state owned concession, part of the Malinau watershed in Bulungan region. Altitude ranges from 100 to 300 m a.s.l. Considered as moist tropical climate, the average annual rainfall is 3,5 to 4 m with an average annual temperature of 27 C°. Lowland to hill Dipterocarp forest is cut for the first cutting cycle in most of this area, under the Indonesia selective cutting system. The allowed minimum tree size at dbh (diameter breast height) is 50 cm.

We decided to focus our study on the catchment headwater (third to fourth stream order), because it is a reasonable generalisation that the impacts of land use are most severe upon smaller, headwater channels.

Samples were taken during 3 months of field work in summer 2000. 19 sites have been selected, distributed over 14 rivers, 10 rivers with third or fourth stream order (12 sampling sites) and the 4 remaining with more than fourth stream order (7 sampling sites).

The main parameter to assess logging activity and intensity is the proportion of the catchment area which is logged, as well as the date of logging. On the 19 sampling sites, 7 are on streams in unlogged areas and 12 in logged areas with the following distribution: 2 sites in an area where the logging road was already built and the area open with logging activities starting, 3 sites in an area logged in 1999, 2 sites logged in 1998, 2 sites logged in 1996 and 3 sites logged in 1995. The proportion of the area logged was measured for some of the catchment by mapping in the field the logging roads and skid trails, together with their width, length and canopy opening.

At each sampling sites we performed:

- 3 quantitative Surber net samples (net with 250  $\mu$  mesh, area 1/10 m<sup>2</sup>) of the river bottom and 1 hour qualitative samples, in order to collect macroinvertebrates
- physical parameters and habitat assessment include: air and water temperature, pH, conductivity, transparency, flow, canopy opening under the stream, substrate composition, vegetation on the bank, etc.

### Preliminary results

The collection of 6500 individuals has been identified during 3 months to the level of order and family for most of the individuals with focus up to the generic level for

Ephemeroptera order. We notice a high taxonomic richness with 17 orders, 40 families and 60 genera and very low abundance, compared to other parts of the world, with mean number of individuals per m<sup>2</sup> ranging from 420 to 1145.

Considering richness and abundance, we notice an increase in the number of individuals at the early stage of logging activities with road building, followed by a drop one and two years after logging. In absence of ongoing logging activities, the fauna start to recover within 4 to 5 years after logging.

With preliminary focus on Ephemeroptera order, differences appear in taxa encountered in logged and unlogged area. 7 genera occur in unlogged sampling sites only and are absent in the logged sites, whereas 3 genera emerged in the logged sites without having been recorded in the unlogged sites. This interesting perspective to identify key species has to be developed and confirmed with the second field sampling campaign.

Habitat assessment and physical parameters do not bring spectacular results. Amongst the information extracted, water temperature in logged streams are slightly higher than in unlogged streams. Substrate composition analyses show that sand appears in all logged streams, with its proportion decreasing with time after logging.

### Conclusion and perspective

- Logging activities have an influence on macroinvertebrate composition, but confirmation is needed with second field sampling.
- Abundance and richness is lowest one

year after logging when the proportion of sand is highest

- The subsequent increase of biodiversity indexes indicates the slow recovery of the river system in absence of any ongoing logging
- Analysis of one insect order at the generic level adds complementary information on tolerance of selected taxa
- Second fieldwork is planned for March-April 2001 where the 19 sites will be sampled again. Most of the unlogged areas have been logged at present, which will give us information on the same sampling sites before and after logging activities.
- Faunistic and environmental variables will be studied in detail to identify the most important parameters and the most informative taxa
- Information at the landscape level is being processed, but is not ready yet to be discussed

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### CONSERVATION IN THE TIGRAY HIGHLANDS, NORTHERN-ETHIOPIA

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#### 1. Introduction

Ethiopia is regularly affected by serious droughts, but a long-term tendency towards increasingly dry weather conditions cannot be distinguished in the highlands of Tigray. Nevertheless, there are many indications that, even under normal rainfall, streams once perennial have become intermittent, streams still perennial have a reduced dry season base flow and springs are drying out (Hunting, 1974). Gully incision is one cause for further drainage of the water table (Nyssen *et al.*, 2000). Forest rehabilitation could play a key role in halting the desiccation of Tigray.

#### 2. Forest degradation and reforestation efforts

##### 2.1. Forest degradation

Despite the rather low and generally badly distributed rainfall, much of the Tigray plateau was once a naturally forested terrain. Impoverishment of the increasing highland population and their search for immediate subsistence has led to massive deforestation (Chadhokar & Solomon Abate, 1988). Today, Tigray has lost virtually all of its forests, much of its wildlife and a great part of its soil and permanent stream flow. Forest remnants have often been overexploited by

### FOREST REHABILITATION AND WATER

systematic fuel wood extraction, logging of valuable timber (e.g. *Juniperus procera* and *Olea europaea*), illegal grazing and unintentional fire (Hunting, 1974). As a result of this massive environmental degradation, the inhabitants now are more vulnerable to periodic drought and crop failure.

### **2.2. Recent reforestation efforts**

Pilot reforestation schemes were established since 1970. They usually involved terracing of the slopes and planting of seedlings grown in nurseries, but were very expensive and largely destroyed the relic vegetation. Much of the success of the forestation terracing lies in the natural regrowth of weedy vegetation following exclusion of grazing animals (Hunting, 1974).

For this reason, several areas were closed for cattle since the mid-eighties. Recently, the Relief Society of Tigray (REST), an environmental rehabilitation and agriculture department, initiated the large scale creation of such enclosed areas. Although they have very clearly stated their operational objectives, they do not have the scientific capacity to follow the evolution of the enclosed areas.

Recent eucalypt plantation activities in some of the closed areas may raise questions concerning socio-economical and ecological sustainability. Questions may arise on the high cost of plantations versus the low survival rate of the trees and on the effects on the water balance, erosion resistance and biodiversity in the closed areas. Dense plantation schemes may lead to monospecific 'forests' of eucalypts lacking mixture of indigenous species.

### **3. Forest rehabilitation through natural regeneration**

Not the trees themselves play the dominant role in soil protection and water conservation but rather the shrubs, herbs and leaf litter associated with forest ecosystems (Hunting, 1974), along with appropriate physical conservation measures. Eucalypt plantations might never evolve into a forest ecosystem that efficiently protects the soil. This is one of the main reasons why natural regeneration or artificial regeneration with indigenous species is preferable.

In order to catalyse the natural regeneration of a forest ecosystem, one should focus on stimulating the natural succession. One approach could be the plantation of so-called *framework tree species*, relatively fast growing indigenous tree or shrub species that attract seed dispersing animals such as birds, which are still abundant in the Tigray highlands, and thus promote the dispersal of seeds from remnant forest patches into the forest rehabilitation areas.

The Katholieke Universiteit Leuven (Belgium) and its partner institution Mekelle University (Ethiopia) are carrying out a joint research project in Tigray to contribute to the restoration of Ethiopia's forest resources and its multiple functions, such as supply of fuel wood and other essential forest products, erosion prevention, water harvesting and conservation of biodiversity. Furthermore, the project aims to contribute to the capacity building of resource monitoring and management by local authorities and communities.

In particular, the project's goal is to expand the scientific base for natural forest rehabilitation in the Tigray region by strengthening of the research capacity on forestry at Mekelle University and increasing the knowledge and awareness of the



stakeholders (e.g. policy makers, forestry extension officers, commercial foresters, local communities and farmers) through a participatory exchange of skills. Finally, the project wishes to contribute to the biological conservation in Tigray by identifying those areas that are best suited for natural forest rehabilitation and by formulating sustainable management practices for the remaining forest fragments and the existing forest rehabilitation areas.

### Acknowledgements

The research project '*Forest Rehabilitation through Natural Regeneration in Tigray, Northern-Ethiopia*' is a joint research project of the Katholieke Universiteit Leuven (Belgium) and its counterpart Mekelle University (Ethiopia). The Belgian Government funds the project through the Vlaamse Interuniversitaire Raad (VL.I.R.). Jan Nyssen, K.U. Leuven research scientist in Tigray is thankfully acknowledged.

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### **ANTHROPOGENIC DISTURBANCE CHANGES THE DIVERSITY AND THE STRUCTURING MECHANISMS OF ARTHROPOD COMMUNITIES OF PRIMARY RAIN FORESTS**

*By Andreas Floren and K.Eduard Linsenmair*

Tropical forests are still being destroyed with increasing rate without our possessing even the most basic knowledge about the functioning of these ecosystems. We do not even know to the order of magnitude the extent of species diversity and consequently cannot judge how many species have already become extinct through this ruthless forest exploitation. A question of central importance is how human impact changes these ecosystems and whether changes are reversible or whether they lead to irreparable damage. This is in the focus of our research in SE-Asian lowland rain forests (in Sabah, Malaysia) in which we analyse how anthropogenic disturbance affects arboreal arthropod communities.

Tree crowns harbour distinguishable arthropod communities which can be sampled in a tree specific and almost quantitative way with our selective canopy fogging method. Fogging was carried out with natural pyrethrum, an insecticide which has no persistent effects, is not toxic for vertebrates, and which quickly degrades within a few hours. This method allowed us

not only to analyse alpha and beta diversity of the arboreal arthropod communities, but also to study colonisation dynamics by re-fogging individual trees after different periods of time. Our investigation was carried out along an anthropogenic disturbance gradient. The forests have been cleared 5, 15, and 40 years ago, used some years for agriculture, and were then left to natural regeneration. All merged into one another with primary forest representing the final stage. From each forest type at least ten trees of the same species that occurred in sufficiently large numbers were chosen for the comparison.

The focus of our analysis was on Formicidae as the most important predators in the tropics and on phytophagous Coleoptera which should rather form tree specific communities on conspecific trees. We quickly recognised that ants are particularly suited for analysing changes on the community level because they are of moderate species richness and nest in the trees thus forming permanent communities. In contrast to all theoretical expectations, according to which ant communities should be structured by interspecific competition, the ant communities of the primary forests could not be distinguished from randomly composed communities (Floren & Linsenmair in press). We have no proof that ants establish a fixed dominance hierarchy and permanent territories. That could be due to the limitation of food in the trees which make it uneconomic to defend large territories. Furthermore, the ant communities which were re-fogged again after three years showed no predictability in species richness and species composition at all (Floren & Linsenmair 2000). These results demonstrate that species assemblage of ant communities is a very complex process and

greatly influenced by stochastic events. Community composition appears to be random even though deterministic processes, like specific interactions, microclimatic requirements etc., are of importance.

In contrast to the primary forest, conditions were completely different in the disturbed forests. In the 5 year-old forest ant species richness was reduced by about 90%, the proportion of rare species was significantly lower, and species that were rare in the primary forest, had gained dominance and occurred on most trees. This corresponded with a change of the system of species interactions, from weakly interacting species in the stochastically assembled communities in the primary forest to stronger interactions in the disturbed forest communities, as indicated by the occurrence of positive and negative species associations. In contrast to the primary forest, community structure was clearly deterministic in the 5 and in the 15 year-old forest. With increasing time of forest succession communities became more and more unpredictable.

Results for Coleoptera were similar, however, due to their extraordinary high diversity, their communities are difficult to analyse. Although our primary forest data now comprise a total of 79 foggings on 13 tree species, we could not identify a tree specific beetle fauna because most species in each sample were new and abundant species were lacking. Along the disturbance gradient, beetle communities showed similar changes in structure and composition to the ant communities. Composition on the familial level was highly variable while always Chrysomelidae, Staphylinidae, and Curculionidae contributed both most specimens and species in the primary forest.

Again species diversity was significantly lower in the disturbed forests, some species occurred on most trees, and the mean correspondence in species composition was greatest in the most disturbed forest types. During the course of forest succession communities became more and more similar to those of the primary forest.

Corresponding changes on the community level were also found in other taxa currently under analysis, namely Ichneumonidae, Arachnida and Orthoptera. This led us to conclude that anthropogenic disturbance changes primary forest ecosystems not only on the species level but also fundamentally on the functional level. Transition of communities, from seemingly stochastically composed communities in the primary forest to deterministic communities in the disturbed forests, might follow a general principle which has been overlooked until to date. Although changes in communities in disturbed forests are often recognised, no study relates these changes to ecosystem dynamics.

We want to emphasise that the disturbed forests lay close together and finally merged into primary forest so that species could easily colonise younger forests. Today, however, most forest fragments are isolated from primary or even old secondary forest and colonisation is therefore very much impeded. All the more our results indicate that most arboreal primary forest arthropods

are not able to establish viable populations and will die out in disturbed forests. Therefore changes in communities of isolated forest fragments should be even more pronounced. This is currently being investigated in the tropics as well as in temperate forests of central Europe.

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Anthropogenic disturbance changes the structure of arboreal tropical ant communities. *Ecography*, in press.

### ARTICLES SOUGHT

Mike Philip, editor of the Forests, Trees and Livelihoods Journal (formerly the International Tree Crops Journal), is looking for authoritative articles for FT&L. The journal covers an holistic field connecting forests, trees and people. Naturally all aspects of community forestry fall within this scope; Mike is especially looking for articles on: techniques in participatory research; all aspects of NTFPs; ethical trading; and impacts of carbon offsetting programmes on rural livelihoods. The readership is international, but reports of research with a mainly local impact may be published as short research notes. You may contact Mike at: philipfor@aboyne93.fsnet.co.uk

Source: Forest Information Update, Vol 2, No 25, 18 June 2001

### OFFICIAL DEFINITIONS OF FOREST, FOREST LAND AND TREE

Gyde Lund of Forest Information Services has updated his web pages on key forest classification terminology. For definitions of definitions of forest state, stage, and origin (old growth, pristine, ancient, natural, plantation forest, etc.) see <http://home.att.net/~gklund/pristine.html>. For definitions of agroforestry, urban forestry, forest health, sustainable forest management, etc. see <http://home.att.net/~gklund/moredef.html>. For listings of definitions around the world for forest, woodland, tree, afforestation, reforestation and deforestation, etc. see

<http://home.att.net/~gklund/DEFpaper.htm>. Warning - this is a large file - approx. 1300K.

Gyde is still seeking national or official definitions of forest, forest land and tree for the following countries: Algeria, Angola, Azerbaijan, Bahamas, Belize, Bosnia and Herzegovina, British Virgin Islands, Brunei Darussalam, Cayman Islands, Chad, Congo (Zaire), Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, French Guyana, French Polynesia, Greenland, Guadeloupe, Guam, Guinea, Guinea Bissau, Iraq, Jordan, Kazakhstan, Korea, Dem. People's Rep., Kuwait, Liberia, Libya Arab Jamahiriyy, Macedonia, Malta, Martinique, Moldavia, Republic of, Mongolia, New Caledonia, Nigeria, Oman, Palestine, Reunion, Rwanda, Saudi Arabia, Senegal, Singapore, Solomon Islands, Sri Lanka, St. Helena, St. Kitts & Nevis, St. Vincent & Grenadine, Surinam, Swaziland, Syrian Arab Rep., Turkmenistan, United Arab Emirates, Uzbekistan, Western Sahara, and Western Samoa.

If you can assist with any definitions for the above countries, please notify Gyde Lund at:

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Source: Forest Information Update Vol 2, No 16, 16 April 2001

### CARBON SEQUESTRATION POTENTIALS FOR TROPICAL FORESTS

Heather Miewald writes, "I am working on a feasibility study for a carbon sequestration project for the Mount Cameroon Project in Limbe, Cameroon. I have come across numerous figures for the carbon sequestration potential for primary and secondary forests, but I was wondering if anyone knows of reliable information on carbon sequestration potentials specifically for tropical forests, especially in sub-Saharan Africa? Any information at all on this subject would be most helpful. I am also looking into different carbon monitoring and accounting (i.e. ton years) methods, and methodologies for baseline establishment. The project is particularly interested in the use of GIS for baseline establishment and monitoring purposes. I would be interested in corresponding with anyone involved in carbon sequestration projects anywhere."

If you can help, please contact Heather at Mount Cameroon Project, Limbe, Cameroon. [heathermiewald@aol.com](mailto:heathermiewald@aol.com)

Source: Forest Information Update, Vol 2, No 30, 23 July 2001

### SEARCH FOR PhD POSITION

Christine Levant has an MSc in Ecology (DEA -advance study diploma- 3rd cycle of university), from the University of Pierre et Marie Curie in Paris. Her study involved:

- population genetics, modelisation, biological statistics, population dynamics, sexual reproduction, life cycle, ethology and tropical biology.
- 6 months probationary period of research application at the Ecology and Evolution Laboratory in the ENS de Paris about the impact of biodiversity variation of pollinisators on the plants community.

Ms Levant is now looking for a PhD position; her interests are in the conservation of biological resources and species and animal population dynamics.

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By Jelle Maas

In the past UNESCO (United Nations Educational, Scientific and Cultural Organization) has paid attention to the subject of forests and water in the form of publications. An overview of their publications, with extended summaries, can be obtained at:

**<http://www.unesco.org/mab/>**

The Tropical environmental hydrology program (TRENDY), a project of the Hydrogeology Section, Faculty of Earth Sciences, Free University of Amsterdam, investigates water-, sediment- and nutrient dynamics of forested areas, from micro- to meso-catchment scale, and the effects on these resulting from deforestation and re-forestation. More information at: **<http://www.geo.vu.nl/users/trendy/>**

The associated projects on forest hydrology in Jamaica and Puerto Rico are presented at respectively

**<http://www.geo.vu.nl/~geomil/rh-res.html>** and

**<http://www.geo.vu.nl/~geomil/js-pr.html>**

The thesis resulting from the latter project is available at:

**<http://flow.geo.vu.nl/thesis/thesis-fin.pdf>**

As a first step in modelling, a versatile yet robust one-dimensional soil-vegetation-atmosphere model (VAMPS, **<http://flow.geo.vu.nl/vamps/vamps.html>**) was developed.

A closely related initiative is the Catchment Research & Modelling Initiative (CRMI, **<http://flow.geo.vu.nl/crmi/>**) jointly developed with International Institute for Infrastructural, Hydraulic and Environmental Engineering (IHE, **<http://www.ihe.nl/>**) in Delft, the Netherlands.

The list of current research projects of the Department of GeoEnvironmental Sciences

of the Free University of Amsterdam may be viewed at:

**<http://www.geo.vu.nl/~geomil/research.html>** . The list includes several projects on forests and water questions in different tropical countries. A list of papers and reports is available from the same page.

Mountain forests are vital as sources of water for irrigation and power generation. They intercept and store water from rainfall, mist and snow, and release it slowly, thereby reducing soil erosion, avalanches and downstream flooding impacts. They are seriously threatened by climate change and a wide range of human activities. As a first step to evaluating global mountain forest resources and the threats to them, UNEP-WCMC (in collaboration with the Environmental Change Institute and kindly supported by the Swiss Agency for Development and Co-operation - SDC) has made a first attempt to map the mountain forests of the world. The results of this effort are presented on this website as regional maps and statistics:

**<http://www.unep-wcmc.org/habitats/mountains/background.htm>**

The Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) has published a number of research updates dealing with work in the area of forests and water, eg 'Trees and water a balanced view', 'Trees as water pumps' and 'Australian Low Rainfall Tree Improvement Group'. Please see:

**<http://www.ffp.csiro.au/publicat/water.html>**

Forests and water are closely related to the subject of climate change (see ETFRN News 26). A useful overview on forests and climate change is provided by IUCN at **<http://iucn.org/themes/forests/policy/Climatechangeandforests.pdf>**

The World Resources Institute (WRI) has a new feature on its website called Earth Trends, providing a wealth of information, with access to databases and maps on different subjects such as climate, marine ecosystems, biodiversity, forests and grasslands and water resources. Take a look at <http://earthtrends.wri.org>

IDRC, the Canadian International Development Research Centre has specific programmes on people, land and water ([http://www.idrc.ca/research/xplaw\\_e.html](http://www.idrc.ca/research/xplaw_e.html)) in which forests play a significant role.

The National Forests in the USA are the site of many hydroprojects, which range from small stock dams to massive power generation stations buried deep within granite mountains. The Forest Service analyzes the environmental impacts of proposed projects, which are then licensed by other federal agencies. More information at: [http://www.r5.fs.fed.us/water\\_resources/html/forests\\_and\\_water.html](http://www.r5.fs.fed.us/water_resources/html/forests_and_water.html)

The topic of the E-conference 'Biodiversity of Water and Forest – Science in support of the Ecosystem Approach' is to discuss how natural dynamics and disturbances of

forests and various forestry management affect biodiversity in freshwater and how natural dynamics and regulation of freshwater affect forest biodiversity. Information on the conference can be found at:

<http://internat.envIRON.se/index.php3?main=/documents/nature/biodiver/EconfForestWater.html>

Gap size, soil condition and microclimate is a project carried out by Oscar van Dam in the framework of the Tropenbos Guyana Programme. His findings were recently published as Tropenbos Guyana Series 10. More information on the project and methodologies used at:

<http://www.geog.uu.nl/fg/ovandam/gapsize.html>

As a first step to evaluating global mountain forest resources and the threats to them, the World Conservation Monitoring Centre (in collaboration with the Environmental Change Institute and kindly supported by the Swiss

Agency for Development and Co-operation - SDC) has made a first attempt to map the mountain forests of the world. The results of this effort are presented on this website as regional maps and statistics:

<http://www.wcmc.org.uk/habitats/mountains/region.html>

## NEW IUFRO-SPDC COORDINATOR

Dr Michael Kleine is the new coordinator for the Special Programme for Developing Countries of the International Union of Forest Research Organizations (IUFRO-SPDC). Dr Kleine takes over from Dr David Langor, who returned to his research position with the Canadian Forest Service, having completed his two-year term with SPDC.

IUFRO-SPDC is implementing the GFIS-Africa Project, which is funded by the European Commission's tropical forests budget line. Information on the development of the Global Forest Information Service (GFIS) is available from the IUFRO website <http://iufro.boku.ac.at/iufro/taskforce/hptfgfis.htm>

Other IUFRO-SPDC activities include the BIOTEchnology assisted REFORestation project (BIOREFOR), and distribution of the "Handbook for Preparing and Writing Research Proposals" by Prof. C. Patrick Reid. This publication is currently being translated to French, and there are plans for workshops on this topic in francophone Africa.

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URL: <http://iufro.boku.ac.at/>

## NEW MONTHLY REVIEW ON MARKETS FOR ENVIRONMENTAL SERVICES

Forest Trends ([www.forest-trends.org](http://www.forest-trends.org)) would like to announce that as of mid-year it will begin issuing a monthly review piece (FLOWS) on recent papers that address topical issues on the interface of hydrology, economics and markets for environmental services. This review is part of a larger initiative to develop an information clearinghouse on markets for environmental services – with an initial emphasis on forests and water - being developed by a number of institutions and interested individuals that have participated in the Katoomba Group meetings. The Katoomba meetings bring together individuals from the public and private sectors, as well as civil society, to discuss cutting edge approaches to developing markets for forest environmental services.

For those interested in subscribing to the FLOWS listserver please send an email to [flows@forest-trends.org](mailto:flows@forest-trends.org) with the word SUBSCRIBE in the Subject line.

For those interested in submitting recent (or older but relevant) papers work for inclusion in future review pieces or for eventual listing in the information clearinghouse, please send the papers to [flows@forest-trends.org](mailto:flows@forest-trends.org) with the word PAPER in the Subject line.

## NEW INTERNATIONAL MASTERS PROGRAMME IN MOUNTAIN FORESTRY

The Masters Programme in Mountain Forestry at BOKU provides academic training to highly qualified students and professionals who wish to specialize in Mountain Forestry. The curriculum



emphasizes interdisciplinarity and learning by doing, and it fosters intercultural communication and team-working, participatory thinking and bottom-up approaches. Applicants must be graduates from an accredited university-level institution (Bachelor/Master's or its equivalents). The programme lasts 2 years and finishes with the completion of a Master's thesis. Graduates of the Master's curriculum in Mountain Forestry at BOKU will have a solid basis for professional activities in administration, extension, community services, private enterprises, research or work in national or international organisations.

until October 31st, 2001.

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<http://ftp-waldoek.boku.ac.at/mountainforestry/>

### **A-WEEK COURSE: PARTICIPATION IN LOCAL DEVELOPMENT**

#### Topics:

- Mountain forest ecology, climatology and hydrology, biodiversity and conservation, inventory;
- Modelling mountain forest ecosystems, multiple-criteria decision making, remote sensing and GIS in natural resource management;
- Natural resources management in mountainous areas (silviculture, agroforestry, wildlife management, forest protection);
- Economics of mountain forests, social issues, politics and policy, managerial economics, project management, participatory methods and tools for mountain forestry applications;
- Road network planning, harvesting systems, risk management, technology assessment, science of natural mountain disasters

The first course will start March 2002, and applications will be accepted

Date: 24-28 September 2001

Location: Nijmegen, The Netherlands

Agromisa is a knowledge centre for the south, focussing on small-scale sustainable agriculture. Agromisa has been organising the course on Participation in Local Development since 1994. The A-week is an intensive five days course which aims to give an introduction on Participatory Approaches that can be used when facilitating Local Development.

Topics that will be treated during the course are: RAAKS (Rapid Appraisal of Agricultural Knowledge Systems), PTD (Participatory Technology Development), PRA (Participatory Rural Appraisal), Theatre for Development, Monitoring and Evaluation and Intercultural Communication. The role of a development worker as a facilitator and the cultural problems one may encounter will be highlighted. Special time will be devoted to group discussions and practical exercises. The course is meant for people working in development programmes, especially for

those who have little or no experience in using participatory methods. The course is open for a maximum of 20 participants and is offered only in English. The A-week is held twice a year. This year the course will be given from 24-28 September 2001 and from 14-18 January.

From 1-5 October 2001 the **A-week Plus** is held for participants that want more participative skills. This course has a more practical focus. The will be finishing the course with an implementation plan for his/her won area. The A-week Plus is for participants that have followed the A-week or that have experience with participative methods.

Fees: NLG 2950,-/ 1250 USD/ Euro 1300,- incl. VAT (Fees include meals, accommodation and course materials). Registration is possible untill two months

before the start of the course.

Please note that Agromisa **cannot** fund course fees, as we are a non profit organisation and we have limited financial resources. In the case you cannot attend the course on the planned date, we could also offer you a "tailor made course", in the Netherlands. In that case, the course can be adapted entirely to the needs and wishes of your organisation and/ or work.

For more information please contact:

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### **CIFOR - COMMUNICATIONS SPECIALIST/WRITER**

The Center for International Forestry Research (CIFOR) is an international organisation with headquarters in Bogor, Indonesia and regional offices in Brazil, Cameroon and Zimbabwe. Established in 1993, CIFOR is committed to enhancing the benefit of forests for all people through research and capacity building. CIFOR's collaborative research, carried out in more than 30 countries with a range of partners, generates scientific knowledge which contributes towards better tropical forest conservation and management in developing countries. CIFOR is funded by over 30 governments and development assistance agencies, and employs 150 staff members.

CIFOR seeks a highly motivated and experienced Writer for its Communications Unit, based at its headquarters in Bogor. The incumbent will be a member of a small team which has the important task of disseminating the results of research by CIFOR and its partners to a wide-ranging audience of policy makers, opinion leaders and donors, as well as to the global forestry/environment community and the media. She/he will be assisted by a network of freelance writers, editors and designers.

The Writer will identify high interest stories from CIFOR's research and ensure that they are written in a range of styles and disseminated in a suitable format. She/he will be a self-starter, able to maintain the highest international standards for the Center's publications and web-site materials, including the annual report, the newsletter, brochures and posters.

The successful candidate will be fluent in English, with proven writing, editing and communication skills. She/he must be able to understand topical issues related to forestry and the environment, and be able to synthesize complex technical information and present it attractively for different audiences.

The candidate should have a degree in journalism, communications, or a related discipline, with a proven track record in environmental journalism, science writing and communications. Knowledge of French or Spanish is an advantage. Ability to function in a cross-cultural and multidisciplinary environment is essential.

CIFOR offers an internationally competitive compensation package, which includes housing, education support for dependants, and comprehensive healthcare coverage.

Applicants should send a letter of interest, curriculum vitae and the names of 3 references, by e-mail, fax or regular mail, to the address below. We will begin considering applications on 15 September 2001 until the position is filled. Only short-listed candidates will be contacted.

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CIFOR is supported by the Consultative Group on International Agricultural Research (CGIAR)

### **ECONOMIC ANALYSIS OF LAND-USE CHANGE IN A WATERSHED CONTEXT**

**a paper presented at a UNESCO Symposium/Workshop on Forest-Water-People in the Humid Tropics, Kuala Lumpur, Malaysia, July 31 –August 4, 2000**

*Bruce Aylward (in prep. 2002)*

This is a paper presented at a UNESCO Symposium/Workshop on Forest-Water-People in the Humid Tropics, Kuala Lumpur, Malaysia, July 31 –August 4, 2000, expected to appear in a Cambridge University Press and UNESCO-IHP volume synthesizing contributions from that meeting.

Land use change that accompanies economic development and population growth is intended to raise the economic productivity of land. An inevitable by product of this process is the alteration of natural vegetation and downstream hydrological function. This paper examines the existing knowledge base with regard to the application of the tools of economic analysis to the valuation of these hydrological externalities of land use change, with an emphasis on the humid tropics.

The paper begins by characterizing in general terms the relationships that govern the linkages between land use and hydrological externalities in humid tropical lowland and upland environments. A brief summary of the hydrological functions concerned (sedimentation, water yield, seasonal flows, flooding, etc.) is followed by a simple theoretical presentation of the linkages between land use, hydrology and economic utility. Hydrological services may enter into an individual's utility function

directly through consumption, indirectly through the household production function or as factor inputs in production. A review of the types of economic impacts that can be expected to result from changes in hydrological services that are, in turn, related to changes in land use is accomplished with reference to the range of such impacts identified in the literature. The general nature of these linkages between land use and hydrological externalities drawing upon the empirical and theoretical ideas is then discussed.

Review of the literature suggests that, though the effects of downstream sedimentation will typically be negative, they may often be of little practical significance. The literature on water quantity impacts is sparse at best. This is most surprising in the case of the literature on large hydroelectric reservoirs where the potentially important and positive effects of increased water yield are typically ignored in favor of simplistic efforts to document the negative effects of reservoir sedimentation.

The paper suggests that on theoretical grounds it would be incorrect to assume that all changes away from natural forest cover must lead to decreases in the economic value derived from hydrological services. Similarly, it is not possible to assume that reforestation or natural regeneration will unambiguously lead to an increase in the economic welfare derived from these services. The paper concludes by identifying lessons learned and making recommendations for future research in the field of integrated hydrological-economic analysis of land use change.

Those interested in an electronic copy of the paper should contact:

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### **DO FORESTS HAVE AN IMPACT ON WATER AVAILABILITY? ASSESSING THE EFFECTS OF HETEROGENEOUS LAND USE ON STREAMFLOW IN TWO MONSOONAL RIVER BASINS**

*Julie Wilk (2000)*

The aim of this PhD thesis (based on five published/accepted articles) was to assess the effects of land use changes on streamflow in two large catchments, the upper Bhavani basin in south India (4100 km<sup>2</sup>) and the upper Nam Pong basin in northeast Thailand (12 000 km<sup>2</sup>). Studies from smaller catchments (of up to one square kilometre) indicate that forest removal will cause an initial increase in total annual streamflow, with the final change dependent on the replacing vegetative cover. On larger catchments of several thousand square kilometres, no changes in streamflow are often found despite the removal of large percentages of forest. In the Nam Pong basin, the forest cover has decreased from 80% to 27% in the last 30 years. Despite this, almost no changes in streamflow patterns or amounts were found. The figure of forest cover depicting a drastic reduction of indigenous forest is in this case partly misleading. In cases where swidden agriculture has been the cause of forest encroachment, large numbers of trees have been left on the land for shade purposes. The density of trees in the catchment has therefore not been as radically reduced (219 trees ha<sup>-1</sup> to 104 trees ha<sup>-1</sup>) as the amount of forest cover. Abandoned plots of land are also a result of the swidden agriculture system, where people move on to new areas after soil fertility is reduced. The secondary

vegetation that grows in has evapotranspiration rates that are close to that of mature forests in only a few years. This would indicate that substituting indigenous forest with a mosaic of mixed vegetation including open land with mixed trees does not drastically affect the quantity of streamflow, in the manner that has been observed in small catchments. The original figures of strongly declining forested areas, may thus be true in terms of continuous areas of indigenous forest but alterations of evapotranspiration and infiltration may not be so extreme as the figures of changes of the percentage of the area covered by forest indicates. The amount as well as condition of different vegetative covers (degraded/healthy or open/dense) is of importance when attempting to understand their cumulative effect on the hydrological regime of a river basin.

Interviews performed with local inhabitants of both catchments found that people in both areas valued trees highly for productivity functions such as firewood, food items, medicines and aesthetic reasons. Forests were also believed very closely linked with sustained water availability in terms of rain and streamflow. There was a strong interest in both conserving the indigenous forests that still exist today as well as retaining and planting scattered trees. This would maintain a landscape mosaic that should according to the results presented in this thesis, not drastically affect streamflow regimes from more indigenous forested conditions.

Study work in the upper Bhavani catchment, India, was riddled with data uncertainties that made modelling work wrought with extra challenges. Even in areas where data is insufficient in relation to the area's

hydrological and climatological complexities, as in the upper Bhavani, people have an interest in knowing as much as possible about the local hydrological regime. It is therefore justifiable to model these areas, if the results are presented and interpreted in light of these data uncertainties. A GIS-assisted method of obtaining more representative areal precipitation was developed and the hydrological data were assessed and crosschecked against each other until an acceptable model calibration was obtained. This was considered sufficiently reliable to run different land use and climate change scenarios to test their relative effects on streamflow. Results supported work in the upper Nam Pong catchment (Thailand) that more heterogeneous land use conditions, indicated from land use maps from 1965 and 1994, showed little changes in streamflow regimes from a hypothetical indigenous scenario (where all agricultural land was converted to the closest indigenous vegetation). Most extreme changes in annual water yield were caused by the scenarios placing the entire catchment under agriculture (streamflow was increased by 19%) and plantations (streamflow was decreased by 33%). Climate change scenarios of increased precipitation of 10% caused an almost equally large increase as the agricultural scenario (17%) but decreasing dry season precipitation caused a negligible change (-5%). Changes in assured reservoir yield (yield that can be assured every year) were also modelled, a measurement which is of greater importance from a downstream perspective where a sustained water flow for agriculture and hydropower purposes is of utmost interest. These changes were more modest than those in mean annual runoff indicating that the effects of the different land uses on

temporal distribution of flow throughout the year and between years are of extreme importance in influencing the amount and timing of water entering the downstream reservoir.

In summary, the retention of heterogeneous land use can buffer the effects of large changes in streamflow as found in small-scale catchment studies. It is very likely that people that enter a forested area to undertake small-scale agriculture will maintain scattered tree groves and even plant new trees for the many products and services that trees are perceived to provide. While some areas of forest are being removed, other areas are probably growing in and the effects of the individual changes disappear in one another. The effects of land use conversion on streamflow thus vary spatially. Forest removal should ensue a large local effect while at a larger scale the effects will usually be buffered out.

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### GOOD EFFORT TO LIFT THE FOG

*By Anders Malmer*

Tropical montane cloud forests have been substantially under researched in relation to the apprehension of their importance as headwater areas for downstream societies. There has been some efforts on reviewing current work, like by Hamilton et al. (1995), but like Bruijnzeel and Veneklaas (1998) state; the fog may not have lifted yet, indicating the

ongoing lack of in depth field study not only of hydrological budgets of these forests but also the major ecological understanding of these forests.

In a printed PhD thesis (Hafkenscheid, 2000) Raimond Hafkenscheid of the Free University of Amsterdam presents a thorough in depth study on forests on the Blue Mountains of Jamaica. The thesis compares two nearby sites of different forest stature and top soils with one of the specific aims to investigate how fog and low clouds contribute to hydrological and nutrient budgets. The low water use by these stunted forests together with difficulties to measure large inputs by occult precipitation, has maintained theories of cloud forests to be of outmost importance to densely populated lowlands, not the least in dry periods. As anthropogenic pressure increases on cloud forests, scientific information is still largely lacking.

Hafkenscheid used both standard "fog gauges" and estimated cloud water interception from troughfall and stemflow in times of no rainfall or more than 2h after rainfall. This lead to conclusions of small contributions of cloud water interceptions to both investigated stands (1.4 – 3.4 % of total input). This was also supported by that the investigated cloud forest stands had similar modelled water budget and transpiration as nearby tall montane forests with "no clouds". In this study no climatic explanations were found to the ecological dispute of the stunting of these mountain forests. Rather, Hafkenscheid argue from his investigations on hydrology and biogeochemistry for the polyphenolic quality of litter leading to low soil pH and Aluminium concentrations

disturbing nutrient uptake and root function. Even though total input of water by cloud interception was low the nutrient input in the more stunted of the two forests investigated was substantial. It is important to acknowledge that the answers from this site may not give the answer for all cloud forests, but sincere and thorough field research efforts like this are essential to find the answers we need. Hafkenscheid points out several recommendations for further research. One of these are to what extent the close to continuous wet leaf surfaces contributes to low transpiration of these forests.

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Bruijnzeel, L.A. and Veneklaas, E.J., 1998. Climatic conditions and tropical montane forest productivity: the fog has not lifted yet. *Ecology*, 79(1): 3-9.

Hafkenscheid, R., 2000. Hydrology and biogeochemistry of tropical montane rain forests of contrasting stature in the Blue Mountains of Jamaica. PhD thesis, Free University of Amsterdam, 302 pp.

Hamilton, L.S., Juvik, J.O. and Scatena, F.N., 1995. Tropical montane cloud forests, *Ecological Studies*, vol 110, Springer Verlag, Heidelberg.

### **GLOBAL THINKING AND LOCAL ACTION AGRICULTURE, TROPICAL FOREST LOSS AND CONSERVATION IN SOUTHEAST NIGERIA**

*Uwem E Ite*

SOAS Studies in Development Geography

Based on extensive local field research undertaken in and around the Cross River National Park in Nigeria, this book provides a socio-economic study of the tensions between agriculture and nature conservation. Taking a "bottom-up" approach and focussing on the farm household and the dynamics of forest farming at household level, it brings together a wealth of new information on the subject of tropical forestry, the causes and dynamics of tropical rain forest loss and the problematic relations between conservation authorities in National Parks and local people. Its conclusions raise important questions about practical ways forward in the development of such areas.

Contents: Global Thinking: Theoretical Issues: Introduction; Small farmers, tropical forest loss and conservation. Environmental Management Issues in Nigeria: Tropical forest loss and resource conservation; The Cross River national park project. Local Action: Forest Loss and Conservation in Okwangwo Division: Environment and development themes; Agricultural land use: practices and challenges; Rates and implications of forest loss in Okwangwo division; Forest conservation-with-development in Okwangwo division. Synthesis: local rates and global illusions; Bibliography; Index.

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### **FORESTRY, FOREST USERS AND RESEARCH: NEW WAYS OF LEARNING FIRST PUBLICATION IN ETRN SERIES**

*Anna Lawrence (ed)*

The first publication in the new ETRN Series has now been published. Entitled "Forestry, Forest Users and Research: New Ways of Learning", and edited by Anna Lawrence, the book provides a sampler of current research with forest users. In participatory development change is brought about through new knowledge, which is treated not merely as a product to help decision-makers, but as a process of empowerment where local communities take over their own development. This has two important implications for researchers: development can involve the creation of knowledge; but conversely, research where the learning processes are only one-way can reinforce power structures



which block participatory development. The book includes a discussion on how the research and learning approaches presented can affect that process. The book is a result of the ETFRN workshop "Learning from Resource Users: a paradigm shift in tropical forestry?" which was held in Vienna on 28-29 April 2000. The ETFRN Focal Point for Austria (ANN-ETFRN) brought together participants from 15 countries to examine the implications of recent experience involving local knowledge in forestry. The debate looked at both studies of local knowledge, and ways of creating new knowledge. This book is the result of that debate; most of the chapters began life as papers at the workshop while others have been added to create a book which illustrates the diversity and innovativeness of research with forest users. We hope it will stimulate reflection on the future of forestry research. It is principally a book for researchers, but we believe it will also be valuable to forestry and development practitioners, to research funders, development donors and policy makers.

The workshop and proceedings were sponsored by ETFRN; the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management; the Austrian Federal Ministry of Education, Science and Culture; and the University of Agricultural Sciences (BOKU).

Copies of the publication are available free of charge, courtesy of the European Commission INCODEV programme. If you would like to receive a copy, please contact the ETFRN Coordination Unit at: [etfrn@iac.agro.nl](mailto:etfrn@iac.agro.nl) (Full address on back page of this issue).

### HUNTING IN THE TAÏ REGION

*Casapary, H.-U., Koné, I., Prouot, C. and Pauw, M. de (2001)*

Game is an important food resource in West Africa, but in Côte d'Ivoire hunting is forbidden. Hans Ulrich Caspary and his colleagues argue that only regulated reopening of hunting will be able to reduce poaching in protected areas. Sustainable wildlife management is urgently needed.

Poaching is a typical phenomenon all over Côte d'Ivoire and the Taï region, at the border with Liberia, is no exception. The influx of migrants has increased the pressure in land and the marginalised farmers need access to game resources for their animal proteins and to supplement their income. The illegality of hunting means, however, that the marketing of bush meat does not generate any incomes for the state, while the local population does not have any say in wildlife management. These problems could be solved under a new sustainable game management strategy. To support such a strategy, a study was carried out under the Tropenbos Côte d'Ivoire Programme in 1998-1999 to shed light on different forms of hunting and the various links in the bush meat supply chain in the Taï region.

The results showed that in the Taï region there are about 73,000 subsistence hunters, 2,200 semi-professional hunters and 220 professionals. In the park itself there are about 20,000 subsistence hunters, 600 semi-professional and 60 professional hunters. The yearly game takeoff by the subsistence hunters, who operate principally in the peripheral zones of the park, is estimated

between 1,500 and 3,000 tonnes and is valued at US\$ 1.5 to 3 million. The catch of the hunters, mainly rodents and other small game, reflects the impoverished range of wildlife. The professional hunters' takeoff, working in the park itself, is estimated at between 56 and 720 tonnes (valued at US\$ 43,000 to 920,000). Monkeys and bovidae dominate the hunting catch.

Hunting in the Taï region is highly destructive. In order to preserve the unique biodiversity of this and other regions, sustainable wildlife management models need to be developed. These models should combine protection and utilisation and be applied in close collaboration between all parties concerned. A list of recommendations is provided to facilitate the development of wildlife management.

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### **SURVEY OF ETHNOBOTANICAL LITERATURE FOR WEST AND CENTRAL AFRICA**

The African Ethnobotany network Bulletin #2 (August 2000) presents a review – in both English and French - of ethnobotanical literature for Central and West Africa. This survey complements the literature review for Eastern and Southern Africa which was published in the networks' previous bulletin. The bulletin also includes a directory of participants in the African Ethnobotany network. The bulletin was published by the Association for the Taxonomic Study of the Flora of Tropical Africa; the People and Plants Initiative; UNESCO and the World Wide Fund for Nature.

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### **NON-TIMBER FOREST PRODUCTS IN CHINA'S YUNNAN PROVINCE, LAOS, AND VIETNAM**

The Yunnan Sino-Dutch Forest Conservation and Community Development Project (FCCDP) organised a regional seminar on the role of Non-timber Forest products in forest conservation and community development in Simao City, Yunnan, P.R. of China, 11 – 14 December 2000. It was the first time that such a regional seminar was held, bringing together expertise from the three countries. China's Yunnan province, Laos and Vietnam have similar cultures and natural resources, sharing the Mekong and Honghe River valleys.

The proceedings of the seminar include the seminar summary, working group results, and several of the background papers submitted participants. The papers present an insight in present activities and ideas on NTFPs in the region.

The International Seminar on Non-timber Forest Product – China Yunnan, Laos, Vietnam

J. van Rijsoort and He Pikun, (editors) 2001,

ISBN 7-81068-271-7/S.21

Published and Distributed by Yunnan University Press, Kunming, P.R. of China, Price 40 RMB

### **PILOT ANALYSIS OF GLOBAL ECOSYSTEMS (PAGE) – FOREST ECOSYSTEMS**

*E Matthews, R Payne, M Rohweder and SMurray (2000)*

The Pilot Analysis of GlobalEcosystems (PAGE) aims to provide an overview of ecosystem condition at the global and continental levels. The second objective of PAGE is to identify the most serious information gaps that limit our current understanding of ecosystem condition. The study reports on five major categories of ecosystems:

- agroecosystems
- coastal ecosystems
- forest ecosystems
- freshwater systems
- grassland ecosystems

The report on forest ecosystems includes analyses of datasets at the global, national and subnational level, drawing on published and unpublished scientific studies. The authors have developed indicators describing the condition of the world's forests, defining condition as the current and future capacity of forests to provide the full range of goods and services that humans need and consume.

The indicators studied include forest extent, change, and human modification; as well as the following forest goods and services: industrial roundwood production; woodfuel production; biodiversity; carbon storage and sequestration; and watershed protection. The choice of this limited set of goods and services was based on consultations with forestry experts in many countries, and on the availability data. On all the indicators listed above, key findings regarding forest condition and trends, as well as quality and availability of data are presented clearly and concisely in

the executive summary.

The authors conclude that despite an abundance of accessible information and expertise, the uncertainty of much of what we think we know about forests is sobering. They found that it was most difficult to find reliable data on woodfuel and biodiversity. It was noted that the single biggest change over time was the clearance of forests to make way for agricultural land. They further conclude that while forests have most actively been managed for wood products, under the assumption that other forest goods and services would more or less take care of themselves, there are signs of change in both industrialised and developing countries. Forest management practices and legal protection reflect increasing recognition of the need to manage forest for multiple benefits and actors, and to make conscious decisions on trade-offs when they become inevitable. However, the full range of goods and services that forests provide is rarely factored into development decisions and our current information base does not allow us to consider and weight different goods and services in an integrated way.

The report is published by the World Resources Institute, Washington DC, USA.  
Available at: <http://www.wri.org/wr2000>  
Printed copies may be ordered from:  
WRI publications, PO Box 4852, Hampden Station, Baltimore, MD 21211, USA  
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[Http://www.wristore.com](http://www.wristore.com)

### DEVELOPMENT

The International Centre for Integrated Mountain Development (ICIMOD) publishes the ICIMOD newsletter for sustainable development in the Hindu Kush Himalayas, as well as a series of short briefing notes "Issues in Mountain Development". The Winter 2000/2001 issue of the newsletter focussed on mountain flash floods. The Titles of Issues in Mountain Development 2000/4 and 2000/5 are: "Rangeland policies in the Eastern Tibetan Plateau - Impacts of China's Grassland Law on pastoralism and the landscape"; and "Poverty Assessment, Poverty Reduction, and Sustainable Livelihoods: How poverty mapping, institutional analysis, and participatory governance can make a difference.

Both the newsletter and the Issues in Mountain Development are available on the ICIMOD website: <http://www.icimod.org.sg>

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### NEWS ON SUSTAINABLE MOUNTAIN

### INDICATORS FOR COMMUNITY MANAGED FOREST LANDSCAPES : AN INTRODUCTORY GUIDE

*B Ritchie, C McDougall, M Haggith and N  
Burford de Oliveira (2000)*

Based on the outcomes of past field testing in several countries as well as work in progress, this guide incorporates results from Cameroon, Brazil and Indonesia and other ongoing research into community forestry, and participatory decision making and learning.

The guide introduces criteria and indicators of sustainability for community managed forest landscapes (CMF C&I) as a potential learning and communication tool that can assist in adapting community forest management systems sufficiently quickly and effectively to meet the rapid changes in their political, socio-economic, and biophysical contexts. It provides insights into a flexible step-by-step approach to developing and implementing self- or collaborative forest monitoring systems, and gives examples of C&I developed by communities in Cameroon, Brazil and Indonesia. The approach is targeted to communities and their partners in forest management (like NGOs, government, or development projects) seeking strategies to improve local well-being and sustainable local forest management.

*Orders: ISBN: 979-8764-439. 104 pp.  
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<http://www.cgiar.org/cifor>*

### SECONDARY FOREST SUCCESSION : PROCESSES AFFECTING THE REGENERATION OF BOLIVIAN TREE SPECIES

PROMAB SCIENTIFIC SERIES 3

*by Marielos Peña-Claros (2001)*

Conversion of tropical forest into agricultural fields has increased over the last decades. When these fields are abandoned, vegetation recovers by secondary succession and secondary forest are formed after some years. This PhD thesis reports on processes that affect the course of secondary succession in the Bolivian Amazon. Processes such as seed predation, germination, seedling survival and growth are studied in detail. In this way insight is gained into the processes limiting the regeneration of tree species in secondary forests differing in age. In addition, this thesis reports on a method for enrichment planting with *Bertholletia excelsa* seedlings in secondary forests.

Orders: Copies of this thesis can be downloaded from:

[Http://www.library.uu.nl/digiarchief/dip/diss/  
1954487/inhoud.htm](http://www.library.uu.nl/digiarchief/dip/diss/1954487/inhoud.htm)

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**MORE TECHNICAL NOTES ON TREE SEEDS FROM PROSEFOR**

PROSEFOR, financed by DANIDA, is the forest tree seeds project of CATIE, Centro Agronomico Tropical de Investigacion y Ensenanza, in Costa Rica. The project publishes a series of technical notes, in Spanish, on forest tree seeds. The notes summarise information available on seed production and management for some of the most important species of Central America. See ETFRN News 22, 23, 25, 26, 27, 30 for previous technical notes.

- No 117 *Gledistia amorphoides* (Grisebach) Taubert.
- No 118 *Tecoma stans* (L.) Kunth ex HBK.
- No 119 *Lysiloma bahamensis* Benth.
- No 120 *Cornus disciflora* DC.
- No 121 *Luehea divaricata* Martius & Zuccarini

- No 122 *Lecythis ampla* Miers.
- No 123 *Parkinsonia aculeata* L.
- No 124 *Pinus tropicalis* Morelet.
- No 125 *Hibiscus elatus* SW.
- No 126 *Juglans olanchanum* Standl. & L.Wms
- No 127 *Cabralea canjerana* (Vellozo) Martius subsp canjerana.
- No 128 *Pinus greggii* Engelm.
- No 129 *Hura crepitans* L.
- No 130 *Dendropanax arboreus* (Linn.) Planch. & Decne.
- No 131 *Trema micrantha* (Linnaeus) Blume.

*Orders: Proyecto Semillas Forestales del CATIE (PROSEFOR), CATIE 7170, Turrialba, Costa Rica. Tel: +506 556 1933, Fax: +506 556 7766.*