Contributions of Center for International Forestry Research to Local Livelihoods and Sustainability Science for Tropical Forests

A Select Bibliography

Introduction by
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Introduction

The bibliography is specifically oriented towards local livelihoods and sustainability science for tropical forests. Sustainability science is the study of the dynamic interactions between nature and society. Tropical forests are vital for social, economic, and ecological reasons. We need to explore the core questions of sustainability science in the context of local livelihoods and tropical forests in order to design robust policy and practice for adaptive tropical forest management. The core issues of sustainability science[1] relevant to livelihoods improvement and adaptive tropical forest management include:

1. **Incorporation of nature–society interactions into models of Earth systems, human development, and sustainability.** Practices contributing to tropical forest sustainability, biodiversity conservation, and livelihoods improvement may help integrate a new adaptive paradigm.
2. **Insights about the changing nature–society interactions caused by long-term trends in population and consumption.** Studying the effects of a growing population on harvest and regeneration can provide insights about this core issue. Such long-term trends can provide guidance on tropical forest management and livelihoods improvement.
3. **Contextual factors related to the vulnerability or resilience of the nature–society system.** Factors that save tropical forests from catastrophic shifts also help maintain resilience and usefulness to local livelihoods. Thus, a holistic approach to maintaining tropical forest resilience is necessary.
4. **Limits on resource use.** We need to probe more deeply to get insights about the limits of sustainable harvests in tropical forests, and the factors that promote such desirable behavior in society.
5. **Ethics, incentives, and knowledge that promote sustainable nature–society interactions.** We often find examples where the local management practices of village communities follow a variety of norms and rules. Knowing such systems of incentive structures, including markets, rules, norms, information, knowledge, and wisdom, can improve our capacity to steer interactions between nature and society in a sustainable direction.
6. **Comprehension of crucial knowledge.** For practitioners, a simple monitoring and feedback mechanism must become routine to help them make harvest and management decisions using knowledge networks across scales. This can help in designing the operational systems for assessing sustainability, and monitoring and reporting on ecological and social conditions within tropical forest ecosystems.
7. **Bringing researchers, planners, policy analysts, and practitioners together to learn, decide, and implement adaptive management.** There is an urgent need to integrate the relatively independent activities of research, planning, monitoring, assessment, and decision support into systems for societal learning and adaptive management of tropical forests. Society has been greatly lacking in this regard.

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[1] See, Kates, R.W., W.C. Clark, R. Corell, J.M. Hall, C.C. Jaeger, I. Lowe, J.J. McCarthy, H.J. Schellnhuber, B. Bolin, N.M. Dickson, S. Faucheux, G.C. Gallopin, A. Grubler, B. Huntley, J. Jager, N.S. Jodha , R.E. Kasperson, A. Mabogunje, P. Matson, H. Mooney, B. Moore III, T. O'Riordan, and U. Svedlin. 2001. Sustainability science. *Science* **292**:641–642.

See also, Pandey, D. N. 2002. Sustainability science for tropical forests. *Conservation Ecology* **6**(1): r13. [online] URL: http://www.consecol.org/vol6/iss1/resp13

The sustainability science differs in structure, methods, and content from classical science. The core questions and methodological challenges that sustainability science poses today are indeed the issues that CIFOR has attempted to study and apply to solve the real world coupled problems of tropical forests and human well-being since its early years. For instance, participatory scenario development offers a useful approach for systematically addressing many of the core challenges identified above. Sustainability science would need to address the following methodological challenges[2, 3,4]:

- Spanning the range of spatial scales
- Accounting for temporal inertia and urgency
- Dealing with functional complexity and multiple stresses on human and environmental systems
- Recognizing the wide range of outlooks
- Linking themes and issues (e.g., poverty and livelihoods improvement, ecosystem functions, and climate change)
- Understanding and reflecting deep uncertainty
- Accounting for human choice and behaviour
- Incorporating surprise, critical thresholds, and abrupt change
- Effectively combining qualitative and quantitative analysis
- Integrating the local and formal systems of knowledge
- Linking with policy development and action through stakeholder participation

The inability of key scientific disciplines to engage interactively is an impediment to the actual attainment of sustainability. A combination of inter- and transdisciplinary approaches to sustainability must be encouraged[5]. As noted above, another key challenge of sustainability science is to examine the range of plausible future pathways of combined social and environmental systems under conditions of uncertainty, surprise, human choice and complexity. This requires charting new scientific territory and expanding the current global change research agenda. Scenario analysis-including new participatory and problem-oriented approaches-provides a powerful tool for integrating knowledge, scanning the future in an organized way and internalizing human choice into sustainability science[6]. Finally, we need to help citizens participate more effectively in sustainability science and environmental policy debates and actions[7]. Creation and transmission of useful knowledge in addressing all these challenges is essential for our progress towards sustainability.

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[2] Swart, R., Raskin, P. and Robinson, J. 2002. Critical challenges for sustainability science. *Science* **297**: 1994 - 1995.

[3] Pandey, D. N. 2004. Ethnoforestry and sustainability science for JFM. In: Bahuguna, V. K., Mitra, K., Capistrano, D. and Saigal, S. (eds.) *Root to Canopy: Regenerating Forests through Community-State Partnerships*. Winrock International India/Commonwealth Forestry Association-India Chapter, New Delhi, pp.195-209.

[4] Pandey, D. N. 2001. Sustainability science of local communities. *Forum on Science and Technology for Sustainability.* Available at: http://sustsci.harvard.edu/commentary/pandey111401.pdf

[5] McMichael, A. J., Butler, C. D. and Folke, C. 2003. New visions for addressing sustainability. *Science* **302**: 1919-1920.

[6] Swart, R. J., Raskin, P. and Robinson, J. 2004. The problem of the future: sustainability science and scenario analysis. *Global Environmental Change* **14**(2): 137-146.

[7] Kasemir, B., Jäger, J., Jaeger, C. C., Gardner, M. T. (eds.). 2003. *Public Participation in Sustainability Science.* Cambridge University Press, UK, 312 pp.

Bibliography

Andersen, L.E., Granger, C.W.J., Reis, E.J., Weinhold, D., and Wunder, S. 2002. ***The dynamic of deforestation and economic growth in the Brazilian Amazon***. Cambridge, Cambridge University Press. xxi, 259p. This book presents an empirical analysis of the development processes and the economic of Brazilian Amazon deforestation using a large data set of ecological and economic variables. It presents summary statistics and analyse trends for a number of important variables as well as developing econometric models to analise policies and compare outcomes under different scenarios. The analyses based on municipality level data for the entire region at several points in time between 1970 and 1996. Throughout the book the models and analyses pay due respect to the dramatic spatial differences in vegetation, soil, rainfall, market access, population density, and many other important factors. By observing the dynamics of land-use change over such a long period this book provides quantitative estimates of the long-term economic costs and benefits of both land clearing and government policies such as road building. The authors find that some government policies, such as road paving in already highly settled areas, are beneficial both for economic development and for the preservation of forest, while other policies, such as the construction of unpaved roads through virgin areas, stimulate wasteful land uses to the detriment of both economic growth and forest cover. Contents of the book are: Preface; Part I. Overview of Issues: 1. The Brazilian Amazon; 2. Extent of deforestation; 3. Review of sources on deforestation; Part II. Econometric Analysis of the Causes of Deforestation: 4. The DESMAT data set; 5. An econometric model of deforestation; 6. Further analysis - cattle ranching; 7. Urban infrastructure; 8. Carbon emissions from Amazon deforestation; Part III. Economics of Deforestation: 9. Economic analysis of deforestation; Part IV. Alternatives to Deforestation: Extractivism - an Economically Viable Alternative to Deforestation?: 10. Plant extractivism in Brazil; 11. Plant extraction in the Amazon - a spatial analysis; Part V. Policy Implications, Discussion and Conclusion: 12. Policy implications and recommendations; 13. Conclusion; Appendix - Econometric Methods.

Anderson, P. J. and Putz, F. E. 2002. **Harvesting and conservation: are both possible for the palm, *Iriartea deltoidea***? *Forest Ecology and Management* **170**(1-3): 271-283. This paper considers the mechanism of certification to encourage sustainable harvesting and best management practices of *Iriartea deltoidea* Ruiz and Pavon, in the context of current land use and agricultural management in Amazonian Ecuador. To understand the demographic variables that are critical for population stability, data from five plots in each of three different types (mature, secondary, and disserted) were collected. Matric models were used to develop harvesting simulations through which biological constraints on sustainable harvesting were explored. Results showed that harvesting *Iriartea* could fit within current land use. Some forest colonists clear pastures to graze cattle, while others devote land to agriculture, including polycultures of annuals and perennials. In either case, palms can be left standing when forests are cleared. Swidden agriculture depends on fallow period during which secondary forest may begin to generate. These secondary forests are ideal locations for extraction of forest products that fit within the cycle of fallow regeneration in areas near human settlements. Sparing *Iriartea* individuals 5-15 m tall could benefit agriculture, encourage the sustainability of future harvests, and help ensure the future of this palm as a part of the Amazonian landscape. Interview with staff of governmental and nongovernmental conservation organizations investigated the policy context for certification as a mechanism for conservation. Establishing guidelines for harvesting requires input from all stakeholders in the decision, not simply an ecological analysis.

Angelsen, A. 1999. **Agricultural expansion and deforestation: modelling the impact of population, market forces and property rights**. *Journal of Development Economics* **58**(1): 185-218. This paper compares four different modelling approaches to agricultural expansion and deforestation, and explores the implications of assumptions about the household objectives, the labour market, and the property rights regime. A major distinction is made between population and market based explanations. Many of the popular policy prescriptions are based on the population approach, assuming subsistence behaviour and limited market integration. Within a more realistic—particularly for the long term effects—market approach, well-intentioned policies such as agricultural intensification programmes may boost deforestation. Many forest frontier contexts are also characterized by forest clearing giving farmers land rights. Deforestation becomes an investment to the farmer and a title establishment strategy. Land titling and credit programmes may therefore increase deforestation.

Angelsen, A. 2001. **Playing games in the forest: state-local conflicts of land appropriation**. *Land Economics* **77**(2): 285-299. This paper explores possible strategic interactions between the state and local community in games of tropical forest land appropriation. Three typical cases are discussed, corresponding to a development over time of increased resource competition and market integration. The local response to more state deforestation depends on the costs, market, and behavioral assumptions, and less on the structure of the game (Cournot or Stackelberg). The state fuels local deforestation by providing infrastructure (roads) which reduces the net costs of agricultural expansion, or when markets are imperfect and local behavior determined by survival needs. The game structure is, however, important for total deforestation.

Angelsen, A. and Kaimowitz, D. 1999. **Rethinking the causes of deforestation: lessons from economic models**. *World Bank Research Observer* **14**(1): 73-98. This article, which synthesizes the results of more than 140 economic models analyzing the causes of tropical deforestation, raises significant doubts about many conventional hypotheses in the debate about deforestation. More roads, higher agricultural prices, lower wages, and a shortage of off-farm employment generally lead to more deforestation. How technical change, agricultural input prices, household income levels, and tenure security affect deforestation-if at all-is unknown. The role of macroeconomic factors such as population growth, poverty reduction, national income, economic growth and foreign debt is also ambiguous. This review, however, finds that policy reforms included in current economic liberalization and adjustment efforts may increase the pressure on forests. Although the boom in deforestation modeling has yielded new insights, weak methodology and poor-quality data make the results of many models questionable.

Angelsen, A. and Kaimowitz, D. 2004. **Is agroforestry likely to reduce deforestation?**. *In:* Schroth, G., Fonseca, G.A.B., Harvey, C.A., Gascon, C., Vasconcelos, H.L. and Izac, A.M.N. (eds). *Agroforestry and biodiversity conservation in tropical landscapes*. Island Press, Washington, DC. Island Press, Washington, DC., pp 87-106. Is agroforestry likely to reduce deforestation? Most agroforesters for the past 15 years have said “yes”, some adding “by about 5 ha of reduced deforestation per ha of agroforestry adopted.” Authors argue, nevertheless, that in many cases the answer is likely to be either “it depends” or even “no”. The aim of this chapter is to discuss key factors which condition the agroforestry - deforestation link. That is, what makes a “yes” more likely than a “no”? The reformulated

question therefore is: which *types* of agroforestry under what *conditions* are likely to reduce the conversion of natural forest?

Angelsen, A. and Wunder, S. 2003. ***Exploring the Forest-Poverty Link: Key Concepts, Issues and Research Implications***. CIFOR Occasional Paper No. 40, Center for International Forestry Research (CIFOR), Bogor, Indonesia, 58 pp. [This is the most useful review on the topic to date]. This paper provides a global review of the link from forests to poverty alleviation. Definitions are clarified and the key concepts and indicators related to livelihoods and policy reduction and prevention are explored--distinguishing between the analysis and the measurements of poverty. Reviewing the macro-level literature on the relationship between economic growth, inequality and poverty, the authors found that economic growth usually does trickle down to the poor and that poverty reduction without growth is in practice very difficult to achieve. The potentials and limitations of forests in regard to poverty allevition are canvassed and their possible roles as safety nets, poverty traps and pathways out of poverty are explored. The core discussion addresses how forests can contribute to poverty reduction, distinguishing three main benefit categories. Firstly, non-timber forest products serve subsistence needs, may have important gap filling or safety net functions. Secondly, timber has not traditionally been very pro-poor but the current trends of increased local ownership of natural forests, growing tree commercialisation and small scale wood processing could modify that picture. Thirdly, ecological service payments are emerging rapidly but it is uncertain how much the poor will benefit. In conclusion, this paper outlines ten promising research topics, within three broader fields: assessing current forest-based benefits to the poor; exploring emerging market opportunities; and evaluating cross-cutting institutional and extra-sectoral issues. Ten priority issues identified for future research are: A. *Exploring the pro-poor role of forests*: (i) Forest products (subsistence and income) in household livelihood strategies—safety nets and increased welfare; (ii) small-scale wood-based processing enterprise; (iii) economy-wide benefits of forest based rents; (iv) On-site ecological services from forests and trees; B. *Emerging market trends and opportunities*: (v) globalization, trade liberalization and markets; (vi) smallholder tree planting and private sector partnership; (vii) payments for environmental services; C. *Cross cutting institutional and extra-sectoral issues*: (viii) local resource control and land tenure; (ix) decentralization, governance and market regulation; and (x) integrating forests into macroeconomic and poverty strategies. Research on forest products (subsistence and income) in household livelihood strategies—safety nets and increased welfare has a priority and needs to be probed using analytical & conceptual models, literature review and synthesis, secondary data collection and primary data collection and analysis.

Angelsen, A., Shitindi, E.F.K and Aarrestad, J. 1999. **Why do farmers expand their land into forests?: theories and evidence form Tanzania**. *Environment and Development Economics* **4**: 313-331. This paper examines the causes of agricultural land expansion and deforetstion in Tanzania. In the theoretical section, two different -- and partly contradicting -- sets of hypotheses are outlined. These are based on a subsistence approach, emphasising the food or income requirements of farm household, and a market approach, focussing on the relative profitability of agriculture. The statistical analysis shows that increased agricultural output prices, in particular for annual crops, is a major factor behind agricultural expansion. An increase of 1 per cent output prices leads to about 1 per cent increase in agricultural area. Other factors such as input prices, technology and economic growth are tested and discussed, but the conclusions are less robust. The controversial role of population growth in expalining

deforestation is addressed. Generally the results lend support to the market rather than the subsistence approach.

Applegate, G., Putz, F.E. and Snook, L.K. 2004. ***Who pays for and who benefits from improved timber harvesting practices in the tropics?: lessons learned and information gaps***. Center for International Forestry Research (CIFOR), Bogor, Indonesia, 35p. Although reduced-impact logging (RIL) techniques are well known and generally endorsed by tropical foresters, rates of adoption of RIL by loggers have been less than encouraging. The principal impediment to proper planning of logging operations, training and supervision of forest workers, and the other components of RIL is apparently the belief on the part of loggers that these improvements are costly to implement. Although there are reasons to doubt that many forest managers and forest operators are fully aware of the costs of each component of their timber harvesting operations, it cannot be disputed that there are additional costs of implementing some aspects of RIL for some forest stakeholders over some time periods. It should therefore be useful to all parties concerned to disaggregate RIL into its components and to analyse the costs and benefits of each from different perspectives. For example, if timber harvesting companies only obtain a portion of the benefits of RIL, then from their perspective it may not be appropriate to pay all of the supplementary costs associated with implementing RIL practices. To explore this issue in detail, authors analyse four components of improved timber harvesting practices (stock and topographic mapping, directional felling, road planning and construction, and skid trail and road closure) on the basis of who pays the costs of implementation and who derives the benefits over both short and long terms. Authors hope that the information generated will assist in efforts at identifying which improved timber harvesting practices may require incentives and which can reasonably be considered the intrinsic responsibility of the timber harvesting company or contractor.

Arnold, J. E. M. and Pérez, M. R. 2001. **Can non-timber forest products match tropical forest conservation and development objectives**? *Ecological Economics* **39**(3): 437-447. The contributions that non-timber forest products (NTFPs) can make to rural livelihoods, and the fact that their use is less ecologically destructive than timber harvesting, have encouraged the belief that more intensive management of forests for such products could contribute to both development and conservation objectives, and have led to initiatives to expand commercial use of NTFPs. This paper reviews evidence that indicates that this 'conservation through commercialisation' thesis needs to be revised. In practice, the selective nature of market demand, and the uneven distribution of resources of use value within forests, mean that with NTFP harvesting the resource can become altered and degraded. The pressures that market forces can place on local control mechanisms, and the conflicting interests of those using forest resources for subsistence and income generation, can also result in poorer users becoming disadvantaged as NTFP commercialisation is intensified. An approach that recognises such areas of conflict, and attempts to arrive at a realistic balance between development and conservation, is proposed.

Arnold, M. and Persson, R. 2003. **Reassessing the fuelwood situation in developing countries**. *International Forestry Review* **5**(4): 379-383. This comment focuses on how recent information influence household usage of fuelwood and charcoal in developing countries, the supply systems associated with this, and the impacts on forests and livelihoods. Topics covered include: fuelwood consumption trends, patterns of supply, impacts on forests, and impacts on subsistence users, and fuelwoods as sources of household income. In general, the new information outlines in this paper supports arguments developed in the late 1980s

that there is not a fuelwood crisis of such a magnitude, and with such potentially dire consequences in terms of forest depletion, as to require major interventions to maintain or augment supplies.

Arnold, M., Köhlin, G., Persson, R. and Shepherd, G. 2003. **Fuelwood revisited: what has changed in the last decade?** CIFOR Occasional Paper No. 39, Center for International Forestry Research (CIFOR), Jakarta, Indonesia, 35 pp. The impact of woodfuel collection on forests has been controversial and its role in rural livelihoods and deforestation the subject of considerable debate. This study reviews the main dimensions of this discourse and the resulting responses from the forestry sector. It assesses new information that has come to light over the past decade, looking at national and global trends in woodfuel production and use, and the evolution of patterns of urban and rural demand and supply. It examines livelihood and environmental dimensions of relevance to forestry and outlines some of the main issues that warrant additional attention. It is thus intended more as a foundation for further discussion, rather than being a set of prescriptions for action by forestry, though where these are evident they are identified. The available evidence does not substantiate earlier concerns that woodfuel demand has been outpacing sustainable supply on a scale that makes it a major cause of deforestation. It appears the balance between the two is seldom an issue requiring forestry intervention on a national scale. However, the rapid rise in charcoal production and its concentration, to supply large urban markets, certainly warrants further investigation. Overall, the woodfuels situation is an important consideration for particular areas within a country and for particular groups of users and suppliers. Globally, fuelwood consumption appears to have peaked (although charcoal consumption is continuing to rise) and in some developing countries, it now appears to be in decline. However, the total quantities of woodfuels being used, and the number of people using them, are still huge. In poor households almost everywhere, woodfuels are among the main forest related inputs, although the level of attention they receive does not currently reflect this, despite the growing focus on giving forestry a stronger livelihood orientation. Forestry initiatives need to be compatible with the energy sector's objective of helping poor users move up the energy ladder to greater fuel efficiency and alternative fuels. The main task though, is likely to be facilitating access to supplies for those who continue to depend on biomass fuels, for their own use or as an important source of income. Forestry measures will need to integrate meeting this demand into wider forestry objectives, rather than, as in the past, developing responses focusing on the fuelwood issue alone.

Asquith, N. M., Ríos**,** M. T. V. and Smith, J. 2002. **Can Forest-protection carbon projects improve rural livelihoods? Analysis of the Noel Kempff Mercado climate action project, Bolivia**. *Mitigation and Adaptation Strategies for Global Change* **7** (4): 323-337. Authors studied the Noel Kempff Mercado Climate Action Project (NKMCAP), Bolivia, to assess whether forest protection carbon (C) projects can significantly benefit local people. They hypothesized that forest protection can only securely deliver C if significant stakeholders are meaningfully and transparently involved, traditional or customary rights are recognized and their loss compensated for, and there are direct linkages between conservation and development objective. The research focused on 53 members of the communities of Florida, Porvenir and Piso Firme and 36 secondary stakeholders. In each of the villages authors held half-day meetings with community leaders, complemented by semi-structured one-hour interviews with 5, 10, and 7 families, representing 20%, 10% and 8% of each community. The long-term impact of the NKMCAP on the local communities may well be positive. However, in the short run, certain sections of the local communities are financially poorer.

Forest protection projects clearly have the potential to sequester C, protect biodiversity and simultaneously contribute to sustainable rural development, but if they really are to improve rural livelihoods, they must be designed and implemented carefully and participatively.

Aubertin, C. 2004. **Cardamon (Amomum spp.) in Lao PDR: the hazardous future on an agroforest system product**. In: Kusters, K. and Belcher, B. (eds.) *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Product Systems, Vol. 1. Asia*, Center for International forestry Research (CIFOR), Indonesia, 43-60 pp. In Lao PDR domesticated cardamom is often grown in agroforests. The sale of cardamom and buffaloes is often the only source of cash, ranging between US$3 to US$20, or 10% to 40% of total annual household cash income. Under plantation conditions annual household income can be about US$50.

Baviskar, A. 2001. **Forest management as political practice: Indian experiences with the accommodation of multiple interests**. *International Journal of Agricultural Resources, Governance and Ecology* **1**(3/4): 243-263. The multiplicity of interests around forests in India reflects the range of social groups who have a stake in their management. Forestry practices, and the ideologies that legitimize them, have been shaped by the political differences prevailing among these collectivities. This paper examines how power relations intersecting the global, national and local levels affect forest management. It attempts to link the articulation and accommodation of specific interests in forestry to the configurations of power obtaining in particular social and historical circumstances. The analysis focuses on the central role of state institutions and ideologies in shaping forest management and discusses how state practices have changed in response to pressures from global and local actors. In conclusion, the paper examines the potential within contemporary forest management practices to further the objectives of social justice and ecological sustainability.

Belcher, B. 2001. **Rattan cultivation and livelihoods: the changing scenario in Kalimantan**. *Unasylva* **52**(205): 27-34. This article discusses an analysis of the changing role of rattan in people's livelihoods in an area of Kalimantan, Indonesia where it has been cultivated in a traditional rice-swidden system for more than 100 year. An analysis of the changing role of rattan in improving the livelihoods of poor people in Kalimantan, Indonesia, as well as providing jobs and valuable foreign exchange.

Belcher, B. and Kusters, K. 2004. **Non-timber forest product commercialization: development and conservation lessons**. In: Kusters, K. and Belcher, B. (eds.) *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Product Systems, Vol. 1. Asia*, Center for International forestry Research, Indonesia 1-22 pp.

Belcher, B. M. 1998. **A production-to-consumption systems approach: lessons from the bamboo and rattan sectors in Asia**. In: Wollenberg, E. and Ingles, A. (eds.) *Incomes from the forest: methods for the development and conservation of forest products for local communities.* Center for International Forestry Research (CIFOR), Jakarta, Indonesia, 57-84 pp. The paper reviews some important concepts from agricultural and institutional economics and applies them to non-wood forest products. It focuses on the 'production-to-consumption systems (PCS) approach' used by the International Network for Bamboo and Rattan (INBAR). The PCS approach provides a framework within which to assess the opportunities and constraints in existing non-wood forest products systems and to draw lessons from present practices that can be applied to other new or evolving systems. The discussion

considers the production, processing and marketing of biological products according to three dimensions: vertical coordination, horizontal linkages and the intensity of the activity. The three aspects are addressed by considering experience from the agricultural sector and building on it to incorporate the different characteristics of non-wood forest products and the varied goals of non-wood forest product development. The conceptual discussion is followed by an overview of a practical approach to using the PCS method, and a summary of the lessons learned in applying the approach in studies undertaken by the International Network for Bamboo and Rattan (INBSR). Changes to encourage development in a particular PCS are identified and the conclusion provides a review of the PCS approach, the INBAR experience and possible contributions to policy making.

Bhat, D. M., Murali, K. S. and Ravindranath, N. H. 2001. **Formation and recovery of secondary forests in India: a particular reference to western Ghats in South India**. *Journal of Tropical Forest Science* **13**(4): 601-620. This paper analyses the underlying causes of secondary forest formation and recovery in India, particularly the Western Ghats region of south India, from precolonial times to the present. In the pre colonial period, hunter gatherers, shifting cultivators and settled cultivators were the dominant users of forest land, with some limited timber felling by local chieftains and kings. There was limited secondary forest formation following extractive activities by the communities and the State. The State takeover of forests for commercial timber exploitation during the colonial period, the resulting alienation of local community rights, and the over exploitation of forest products from limited areas accessible to the community were key factors in the large-scale formation of secondary forests. In the post independence period, the diversion of forestland for other purposes and industrial pressures led to deforestation and forest degradation. Currently, forest cover is relatively low and primary forests exist only in hilly tracts. However, forest cover has stabilised in spite of increasing population density. With the passing of the Forest Conservation Act of 1980, which banned forest clearing, forest conversion pressures were reduced. During the last decade, the rehabilitation of degraded secondary forests and the regeneration of secondary forest on degraded land by communities have contributed to the stabilisation of forest cover. The paper hypothesises that joint management of forests by governments and communities, as well as policies to reduce dependence on fuelwood, may have paved the way for this favourable development.

Boyle, T. J. 1997. **Impacts of disturbance on genetic resources of tropical forests**. *Current Science* **73**(11): 900-? Preliminary results are reported from a collaborative research project involving 3 countries under the auspices of CIFOR and IPGRI (International Plant Genetics Resource Institute), to investigate how human activities affect the genetic resources of forest species. The study has also involved the reproductive ecology of the species concerned and the socioeconomics of the communities living around and in the forests. The countries involved were Malaysia (where the main human activity involved was logging), Thailand (where the main activities were wood harvesting for construction and fuelwood, and use of forests for grazing and NTFP (non-timber forest products) collection), and India (where the major activities were grazing and NTFP collection). In contrast to NTFP collection, which had a major deleterious effect on genetic resources (resulting in their complete loss for some species), the other activities were much less damaging - loss of genetic diversity due to logging in Malaysia did not exceed 24% (for harvested and non-harvested species overall), and in Thailand wood harvesting only had a significant impact on genetic diversity at very high intensities. The Thai study also demonstrated that the intensity of impact was dependent on the reproductive ecology of the species.

Boyle, T.J.B. and Boyle, C. E. B. 1994. ***Biodiversity, temperate ecosystem and global change***. Heidelberg, Springer-Verlag. 456p.

Boyle, T.J.B. and Sayer, J.A. 1995. **Measuring, monitoring and conserving biodiversity in managed tropical forests**. *Commonwealth Forestry Review* **74**(1): 20-25. Discusses methods for measuring and monitoring different components of biodiversity in tropical forests. Considers the conservation of biodiversity in tropical forests including the use of criteria and indicators, the zonation concept of management, the use of buffer zones, and extractive reserves. Prospects for future conservation and management are discussed.

Braedt, O. and Standa-Gunda, W. 2000. **Woodcraft markets in Zimbabwe**. *International Tree Crops Journal* **10**(4): 367-384. To understand the potential role of forest products in household livelihoods, a study of the woodcraft industry in Zimbabwe was initiated. The woodcraft industry has increased steadily since the late 1980s. The factors driving the upsurge in the woodcraft industry are: (1) the increased demand by tourists; and (2) the need by rural households to find cash income sources. The structural adjustment programme, with one of its emphases being the decontrol of the currency, has probably played a key role in driving the rise in woodcraft production. Although all markets have a committee and all have some basic rules governing their operations, few rules are strictly enforced. There is also a lack of enforcement of the national legislation that governs the use of the tree resources. The local traditional rules governing resource use from the commons are also not strong. Given the problems in the national legislation and in the local rules, it is difficult to see how the resource can be managed on a sustainable basis. It appears that the benefits from the industry may not be substantial given the lack of interest in the market from outsiders, and the various elites who could monopolise the trade due to the lack of enforcement structures in place. In communal areas, where deforestation is advanced, the selective use of certain species for carving is likely to drive the species to local extinction. The carvers are likely to switch to different tree species to maintain their production levels.

Burley, J., Seppälä, R., El-Lakany, H. Sayer, J. and Krott, M. 2001. **Voicing interests and concerns: challenges for forest research**. *Forest Policy and Economics* **2**(1): 79-88. Forest research has to change in response to the increased interest of society in the management of forest land. The president and the vice president of IUFRO, the Assistant Director-General for Forestry in the FAO and the Past Director-General of CIFOR discuss key issues. IUFRO should become a clearing house for forest research and expertise. Research has to recognize that the culture of forestry has become a culture of conflict. More interdisciplinary and policy research should be added to the strong bio-physical sciences in forestry. We need science to exploit the comparative advantages of local and larger-scale forest management and we need science to bridge the gaps between the traditional and modern pools of knowledge and experience.

Byron, N. and Arnold, M. 1999. **What futures for the people of the tropical forests?** *World Development 27(5) 789-805.* The importance of forest products to households living in or near forests has been increasingly recognized. Estimates of numbers of people who in some way rely on forests, for survival or livelihoods, vary widely. Yet numbers alone do not reveal the forests' importance to diverse users. A typology that recognizes the varied relationships of people to forests and forest products permits assessment of the impacts of economic, cultural, and social changes. Understanding these relationships is crucial for institutions to adapt to

changing patterns of demand, use, and supply, and to support both "forest-dependent" and "forest-related" peoples.

Byron, R.N. and Ruiz Perez, M. 1996. **What future for the tropical moist forest 25 years hence?**. *Commonwealth Forestry Review* **75**(2): 124-129.

Byron, R.N. and Sayer, J.A. 1999. **Organising forestry research to meet the challenges of the information age**. *International Forestry Review* **1**(1): 4-10. This paper examines the needs for forest science for the 21st century and ways of organising research to meet them. The world of the 21st century will be one of knowledge-based societies and globalised economies. The need for global stewardship of the environmental and social values of forests is finally being accepted. Yet pressures for economic efficiency and competitiveness are reducing the resources available to state forest agencies. Many countries are transferring management of production forestry to the private sector. Emerging technologies are greatly enhancing our ability to assess and monitor forest attributes, to process and disseminate information as well as to grow trees faster and to more narrow industrial specifications. Such changes will affect how forest science is organised, creating new demands for and new suppliers of, research. Funding responsibilities will be redistributed between the private and public sectors, The private sector can take over conventional forestry research on productivity enhancement, but it is unclear who will fund research supporting the public values of forests at the local, national and global levels.

Campbell, B. and Shackleton, S. 2002. **Organizing for community-based natural resources management**. *Zimbabwe Science News* **36**(1/2): 5-12. There has been a move to decentralize natural resource management (NRM) throughout southern Africa but this has taken many forms, resulting in different organizational structures. A comparative analysis of the devolution and empowerment processes of 14 case studies from 8 countries in southern Africa (Botswana, Lesotho, Malawi, Namibia, South Africa, Tanzania, Zambia, and Zimbabwe) is presented. Four main types of community-based natural resource management (CBNRM), depending on the key organizations for NRM are classified as: district-level organizations; village organizations supported by sectoral departments (e.g. Village Forest Committees); organizations or authorities outside the state hierarchy (e.g. traditional authority, residents' associations); and corporate organizations at the village level (e.g. Trusts, conservancies, property associations). Attitudes towards district-level schemes amongst local people are generally negative. The greater the authority village organizations receive the more likely they are to succeed. In the cases of corporate organizations, local residents have received user or proprietary rights over resources. Such cases indicate the best chances of community-based natural resources management CBNRM being successful. The impact of private sector stakeholders can be positive or negative depending on the institutional arrangements in place. Many of the cases have demonstrated the key role that external facilitation plays in building the capacity of local organizations. Traditional leaders have continued to play a role in NRM, with varying degrees of authority and control.

Campbell, B. M., Costanza, R. and Belt, M. van den. 2000. **Land use options in dry tropical woodland ecosystems in Zimbabwe: introduction, overview and synthesis**. *Ecological Economics* **33**(3): 341-351. The 6 articles included in this special section focus on the ecological and economic interactions of woodland use in Western Zimbabwe. One of the aims was to investigate the use of modelling to achieve integration among disciplines. The integrated model draws on the models in the different papers comprising the special section.

The model has five ecological sectors, five sectors covering woodland use by local people and the state forestry organization, two sectors to cover agriculture, one sector for population growth and land use, a sector to cover carbon sequestration, and a sector to calculate net present values of the various uses. The state has usually attempted to keep people and their livestock out of the state forest. It is shown that the private benefits of cropland may be greater than those related to state or local use of the woodland, but further work is required to incorporate the public costs of subsidies to cropland, and the public benefits of woodland services. Livestock production in the woodlands is compatible with woodland management, both from economic and ecological perspectives. Expulsion of forest dwellers from the state forest makes little ecological impact on the woodland, and does not improve the economic value of the woodland to the state. However, if the Forestry Commission relaxes the current control on in-migration, it is likely that the woodland will be rapidly depleted in the face of massive in-migration. Modelling is seen as a framework for integration of ecological and economic issues, but further work is required to incorporate institutional perspectives from the sociological and anthropological disciplines.

Campbell, B. M., Doré, D., Luckert, M., Mukamuri, B. and Gambiza, J. 2000. **Economic comparisons of livestock production in communal grazing lands in Zimbabwe**. *Ecological Economics* **33**(3): 413-438. During the last decade a 'new rangeland science' has emerged. One of the tenets of the new science is that pastoralists should not adhere to a single conservative stocking rate, but rather adopt an opportunistic strategy, where numbers will fluctuate widely in response to good and bad seasons. It is further argued that opportunistic strategies give higher economic returns compared to strategies based on conservative stocking rates. In the current paper authors compare the economics of four cattle management scenarios. The analysis is based on a simulation model of the fluctuation over time of animal numbers, outputs and prices, using data from field surveys and the literature. Our results suggest that strategies based on conservative stocking rates would have higher net present values than strategies based on opportunistic stocking rates. Previous analyses have failed to account for losses due to drought and the costs of capital tied up in livestock, and the analyses have tended to compare commercial with communal production rather than considering different kinds of small holder production methods. To receive the full benefits of destocking, however, a decision to destock has to be made at the level of the community, as the benefits of improved outputs can only be achieved if the stocking rates of the communal grazing lands are reduced. Making collective decisions about managing numbers is a process with considerable transaction costs, and thus the likelihood of new institutions emerging are lessened. It is surprising that a tight tracking scenario (where numbers of cattle are managed by purchasing and selling so as to maintain numbers in equilibrium with the available feed resources) is being recommended in the most recent literature. Our results suggest that such a system would come with considerable economic losses. The costs of a current programme to reclaim small dams illustrate the environmental costs of the opportunistic scenario. A tight tracking policy is likely to further increase environmental degradation and its associated costs. Several serious flaws are identified that elevate opportunistic pastoral systems as giving higher economic returns than other systems.

Campbell, B. M., Luckert, M. K. and Mutamba, M. 2003. **Household livelihoods in semi-arid regions: is there a way out of poverty?** *Currents* 31/32: 4-10. The overall aim of a three-year study was to explore, using case-study sites in southern Zimbabwe, what the development community can do to improve rural livelihoods in semiarid systems. Most households rely on cash and subsistence income from a number of sources: dryland crop

production, gardening, livestock production, woodland activities, wage or home industries and remittances/gifts. Marked wealth differentiation occurs. Authors suggest that there are some key drivers of change, namely: (a) rainfall, (b) macroeconomic changes, (c) changing institutional arrangements and social processes, and (d) demographic processes and HIV/AIDS. Households have a rich and varied livelihood portfolio, with displays of infinite resourcefulness to make ends meet, but the poverty status of rural households improving in semiarid regions is not seen, with most households being below the poverty line. Rural poverty is the result of a suite of factors and processes operating at a range of scales, implying that there can be no silver bullet to rural development, and that an integrated, multisectoral approach to development is critical, with different, but complementary, activities pursued at different levels.

Campbell, B. M., Vermeulen, S. J., Mangono, J. J. and Mabugu, R. 2003. **The energy transition in action: urban domestic fuel choices in a changing Zimbabwe**. *Energy Policy* **31**(6): 553-562. Two questionnaire surveys of fuel use by low-income households in Zimbabwe were conducted in four small towns in 1994, and in these towns plus four larger towns in 1999. An energy transition from wood through kerosene to electricity occurred (a) with rising household income, (b) with increasing electrification status among towns and (c) over time in the smaller towns, in spite of falling household incomes in two of the towns. Increasing discrepancy in the incomes of higher and lower income groups over time was not associated with greater divergence in their fuel choices. By 1999 electricity was used by almost all households in towns with good electricity supplies, while use of firewood in these towns was infrequent. However, even the wealthiest households continued to combine electricity with other fuels, usually kerosene. Electricity use by less affluent households is apparently limited by lack of connections in the home and by access to appliances, while fuel prices, which are subject to government subsidies and fell in real terms over 5 years, have been less important. Zimbabwe's urban domestic energy policy has had considerable success in terms of equity, but this is increasingly difficult to maintain given present economic and political uncertainty.

Campbell, B., J. A. Sayer, P. Frost, S. Vermeulen, M. Ruiz Pérez, A. Cunningham, and R. Prabhu. 2001. **Assessing the performance of natural resource systems**. *Conservation Ecology* **5**(2): 22. [online] URL: http://www.consecol.org/vol5/iss2/art22 Assessing the performance of management is central to natural resource management, in terms of improving the efficiency of interventions in an adaptive-learning cycle. This is not simple, given that such systems generally have multiple scales of interaction and response; high frequency of nonlinearity, uncertainty, and time lags; multiple stakeholders with contrasting objectives; and a high degree of context specificity. The importance of bounding the problem and preparing a conceptual model of the system is highlighted. Authors suggest that the capital assets approach to livelihoods may be an appropriate organizing principle for the selection of indicators of system performance. In this approach, five capital assets are recognized: physical, financial, social, natural, and human. A number of principles can be derived for each capital asset; indicators for assessing system performance should cover all of the principles. To cater for multiple stakeholders, participatory selection of indicators is appropriate, although when cross-site comparability is required, some generic indicators are suitable. Because of the high degree of context specificity of natural resource management systems, a typology of landscapes or resource management domains may be useful to allow extrapolation to broader systems. The problems of nonlinearities, uncertainty, and time lags in natural resource management systems suggest that systems modeling is crucial for

performance assessment, in terms of deriving "what would have happened anyway" scenarios for comparison to the measured trajectory of systems. Given that a number of indicators are necessary for assessing performance, the question becomes whether these can be combined to give an integrative assessment. Five possible approaches are explored: (1) simple additive index, as used for the Human Development Index; (2) derived variables (e.g., principal components) as the indices of performance; (3) two-dimensional plots of indicators and cases emerging from multivariate techniques used to visualize change; (4) graphical representation of the five capital assets using radar diagrams; and (5) canonical correlation analysis to explore indicators at two different scales.

Campbell, B., de Jong, W., Luckert, M., Mandondo, A., Matose, F. and Nemarundwe, N. 2002. **Can common property resource systems work in Zimbabwe**? *Zimbabwe Science News* **36**(1/2): 13-17. Common property resource (CPR) management approaches are now thought to provide a viable alternative to natural resource management. Our investigations on common property issues for woodlands in communal areas in Zimbabwe revealed numerous cases showing a breakdown of local institutions for CPR management, and the lack of any emerging alternative institutions for such management. A number of economic, social and ecological factors contribute to these problems. Authors argue that current institutional systems are rooted in norm-based controls contrary to the formal rule-based systems that form the cornerstones of the proposed CPR systems. It is suggested that interventions that propose CPR systems need critical analysis.

Campbell, B., Mandondo, A., Nemarundwe, N., Sithole, B., De Jong, W., Luckert, M., and Matose, F. 2001. **Challenges to proponents of common property resource systems: Despairing voices from the social forests of Zimbabwe**. *World Development* **29**(4): 589-600. There is a fair degree of misplaced optimism about common property resource (CPR) management. In investigating common property issues for woodlands in communal areas in Zimbabwe, authors are struck by the numerous case studies showing a breakdown of local institutions for CPR management, and the lack of any emerging alternative institutions for such management. There are a number of contributing economic, social and ecological factors to this phenomenon. Authors argue that the formal rule-based systems that form the cornerstones of the proposed CPR systems are far removed from the current institutional systems, rooted in norm-based controls. It is suggested that advocacy of CPR systems has to be tempered with critical analysis.

Campbell, B.M., Byron, R.N., Madzudzo, P.H.E., Matose, F. and Wily, L. 1999. **Moving to local control of woodland resources - Can CAMPFIRE go beyond the mega-fauna?**. *Society and Natural Resources* **12**(5): 501-509. Devolution of authority over natural resource management is now well advanced for the mega-fauna in Zimbabwe, through the CAMPFIRE program. Authors ask whether models like CAMPFIRE can be applied to a broader spectrum of woodland resources. Problems in applying CAMPFIRE to woodland resources relate to a legal and policy framework that is not enabling to local management; weakened local institutional structures; a high of differentiation with respect to woodland resource use within communities; problems of defining resource user groups; and, the potentially low market value of woodland products. In identifying circumtances where CAMPFIRE may be applied succesfully to woodland resources, economic, sociological, and ecological circumtances must be considered.

Campbell, B.M., Jeffrey, S., Kozanayi, W., Luckert, M., Mutamba, M., and Zindi, C. 2002. ***Household livelihoods in semi-arid regions: options and constraints***. Center for International Forestry Research (CIFOR), Bogor, Indonesia, 153p. The overall aim of this study was to explore what the development community can do, or facilitate, to significantly improve livelihoods in semi-arid systems. The authors based their analysis on two case-study sites (Romwe and Mutangi in Chivi) in the communal lands of southern Zimbabwe. The main tool was a detailed livelihood questionnaire, supplemented by participatory appraisal and observation, action research, biophysical analysis and systems modelling. Most households rely on cash and subsistence income from a number of sources - dryland crop production, gardening, livestock production, woodland activities, wage or home industries and remittances/gifts. Marked wealth differentiation occurs, with local people recognising the different wealth groupings largely on the basis of various capital assets. One factor driving differentiation is whether a household has access to remittance income. Elements of change can be identified in numerous aspects of the capital assets and the livelihood strategies. The authors suggest that there are some key drivers of change, namely: (a) rainfall, (b) macro-economic changes, (c) changing institutional arrangements and social processes, and (d) demographic processes and HIV/AIDS. The overall conclusion is that there are very few options for significantly improving livelihoods in semi-arid regions and that the poverty alleviation targets set by the international community are overly ambitious. The analyses suggest that rainfall variation and the state of the macro-economy are likely to have a greater impact on livelihood status than local rural development interventions. [Arguably, this is also the most robust study of contribution of woodlands to household income and livelihoods]. A vast majority of woodland products are used within the household, with only approximately 9% of the overall value of woodland products being sold for cash. The total value of cash and in-kind income received from the woodlands is Z$3941 per household per year, the cash income being Z$384 and subsistence income Z$3557. The total average cash expense is Z$11,000 per household per year and the average gross cash income is Z$12,600. The similarity in two numbers adds confidence in the study. On average, dryland crops contribute 22% of total net income (cash and subsistence), gardens 8%, livestock 21%, woodlands 15%, wages and home industries 12% and remittances and gifts 21%. About 45% of total net income is cash income. It is notable that cash is at premium as cash income stands at less than US$0.20 per person per day.

Campbell, B.M., Sithole, B. and Frost, P. 2000. **CAMPFIRE experiences in Zimbabwe**. *Science* **287**: 42-43. This article comments on Wayne M. Getz *et al*. who present an optimistic outlook for community-based natural resource management (CBNRM) in their Policy Forum “Sustaining natural and human capital: Villagers and scientists” (see *Science*, 19 March 1999, p. 1855), and suggest that the key is for scientists and villagers to develop partnerships. Communal Area Management Programme for Indigenous Resources (CAMPFIRE), a community-based approach to wildlife management in Zimbabwe, provides “concrete examples of CBNRM success in raising the income levels of poor rural communities,” Getz et al. say. Emerging problems, however, could derail many of the initiatives. A small group of researchers in Zimbabwe have played a key role in the devolution of wildlife management from central to local government. However, in achieving this success, the line between scholarship and advocacy has become blurred. The push for CAMPFIRE has resulted in a concentration of power in Rural District Councils (RDCs), the lowest level of government (1). RDCs generally view CAMPFIRE as a means to raise funds. Our fieldwork in three CAMPFIRE districts indicates that many villagers show little knowledge about CAMPFIRE or view the program as an extension of the RDC or

"government." Even where counselors do represent their communities in the RDC, they may have little bargaining power over benefits derived from CAMPFIRE, because counselors from wards without wildlife schemes are often in the majority. Villagers living with wildlife bear the costs of wildlife (impacts on agriculture), whereas benefits from safari hunting may be spread beyond the community that bears the costs or may be concentrated in the RDC. Authors found that 50 to 90% of revenues from hunting were retained by the RDC, whereas in one district, household dividends were $1 to $3 per household per year. If antelope were poached and sold for meat, they would bring $7 to $20 each. Scholarship is needed to establish under what conditions CBNRM works. There are successful CAMPFIRE schemes, but each district is different, providing rich data for scholars. An emerging hypothesis is that devolution must go lower than the RDC if CBNRM is to be successful. The successes of CAMPFIRE must be built on by developing genuine local participation and ownership. Given that villagers are largely not benefiting from CBNRM, further work on institutional and anthropological themes (power, property rights, incentives) should perhaps be the priority over building technological partnerships between villagers and scientists.

Casson, A. and Obidzinski, K. 2002. **From new order to regional autonomy: shifting dynamics of "illegal" logging in Kalimantan, Indonesia**. *World Development* **30**(12): 2133-2151. In recent years there has been a tendency to view the seemingly irremediable spread of "illegal" logging in Indonesia in isolation, or as a result of disassociated and premediated criminal acts. This paper proposes a different view of the problem by discussing the changing dynamics of the "illegal" logging sector in the two districts of Berau, East Kalimantan and Kotawaringin Timur, Central Kalimantan. It suggests that illegal logging is not a simple case of criminality, but a complex economic and political system involving multiple stakeholders. Furthermore, "illegal" logging is not a stationary condition that can be effectively dealt with through cohesive or repressive measures alone. Rather, it should be viewed as a dynamic and changing system deeply engrained in the realities of rural life in Indonesia. Regional autonomy has also created a supportive environment for the "illegal" logging trade and allowed it to gain resilience.

Chipika, J. T. and Kowero, G. 2000. **Deforestation of woodlands in communal areas of Zimbabwe: is it due to agricultural policies?** *Agriculture, Ecosystems & Environment* **79**(2-3): 175-185. Deforestation and woodland degradation are issues of great concern in Zimbabwe. The debate on these issues has identified a number of causes including expansion of arable land, demand for fuelwood and construction poles, and urban expansion. This paper examined how some policies aimed at improving agricultural production may be contributing to deforestation of woodlands in the communal and resettlement areas of Zimbabwe. Consideration was given to maize (*Zea mays* L.), cotton (*Gosspium hirsutum* L.) and sunflower (*Helianthus anuus* L.); crops with appreciable land area in 1980–90. Regression analysis indicated that policies which improved marketing of grains, provision of credit (largely in form of farm inputs) and extension services, encouraged expansion of land under maize and less so under cotton. High nominal prices encouraged expansion of area under maize while decreasing real prices of cotton, if not reversed, had potential for reducing land under cotton. Increased fertilizer prices, through removal of subsidies as required by structural adjustment policies, had potential for reducing land under maize and sunflower. The driving force for sunflower and cotton production was partly based on the desire, by farmers, for non-declining revenues in successive years. During the same period, real producer prices for these crops were declining and demand for cash was increasing rapidly. The evaluated agricultural policies appeared to have been responsible for moderate expansion

of land area under maize but more significant expansion of land under cotton and sunflower. These policies could have encouraged modest deforestation of woodlands in the Zimbabwean communal and resettlement areas in the period 1980–1995.

Chokkalingam, U. and Alan White, A. 2001. **Structure and spatial patterns of trees in old-growth northern hardwood and mixed forests of northern Maine**. *Plant Ecology* **156** (2): 139-160. Stand structure including spatial patterns was studied in northern hardwood and mixed forest types in the 2000-ha old-growth Big Reed Forest Reserve in northern Maine using complete stem mapping, dendrochronology, and spatial analyses on ~0.5 plots. The inclusion of saplings, dead wood, age distributions, spatial pattern, and interactions provided some idea of underlying processes and temporal change. Structural characteristics were most comparable to spruce-northern hardwood forests of northern New England and New York, and most characteristics matched expected patterns for old-growth forests of the region. Results indicated smaller maximum-tree sizes, lower basal areas (26–34) and downed-wood volumes (29–64), higher densities (475–649), but similar species longevities compared to other mesic old-growth forests further south and in the Lake States. The stands were dominated by very shade-tolerant tree species, including *Fagus grandifolia* Ehrh., *Acer saccharum* Marsh., *Picea rubens* Sarg. and *Abies balsamea* (L.) Mill, with each species found in many crown positions and age and size classes. The sapling layer was dominated by *Fagus grandifolia* followed by *Picea rubens*. Most species had reverse-J shaped diameter distributions, but age distributions were indicative of synchronous, episodic recruitment. In most plots, *Acer saccharum* diameter distributions were skewed towards the mid-larger size classes. Lack of young and small *Acer saccharum* stems suggested change in forest composition towards *Fagus grandifolia* dominance. Most species formed small-scale clusters (≤15) perhaps in response to small gap disturbances. Snags were the dominant dead wood type and were randomly to regularly distributed in most plots. Logfall directions were unrelated to hurricane paths. Recent small-scale disturbance events and topographic position appear to be important in explaining current structure and dynamics of the hardwood and mixed forests of Big Reed Forest Reserve in northern Maine. The continued effects of beech bark disease had a greater effect on hardwood plots, whereas a recent spruce budworm outbreak had a greater effect on plots with higher conifer density. The dominance of very shade tolerant tree species in small-scale clusters, and randomly distributed snags rather than clustered uproots were indicative of the prevalence of small scale gap disturbance regimes in the hardwood and mixed forests of Big Reed Forest Reserve in northern Maine. Varying topographic position may allow for slight changes in disturbance regime leading to consequent variation in structure and dynamics. H1, a more open plot on upper exposed slopes, had distinctly different characteristics such as lower live and dead tree and sapling densities than the other plots, but more uprooted trees and *Acer saccharum* saplings. Such small scale gap disturbance regimes operating on an episodic basis, and effects of slight variations in this regime on stand composition and structure have significant implications for silvicultural interventions and management of these forest types.

Chokkalingam, U. and de Jong, W. 2001. **Secondary forest: a working definition and typology**. *International Forestry Review* **3**(1): 19-26. With past and continued destruction of primary forest worldwide, secondary forest constitute a large and growing component of forest cover and have been found to be very important for a wide range of goods and services. Despite its widespread usage, there is considerable ambiguity with regard to the meaning of the term 'secondary forest' and the different forest types it encompasses. This paper reviews existing definitions, or perceptions, of secondary forests and examines the three main points

of contention: nature (human or natural) of disturbance, intensity of disturbance, and nature of vegetation development matters in its definition. It then arrives at a broad working definition for secondary forests, and develops a secondary forest typology based on the underlying disturbances or land use practices that create conditions for the appearance of secondary forest. Both the definition and typology are based on clear and objective criteria and are generalizable across regions, which should make them widely applicable.

Chokkalingam, U., Bhat, D. M. and von Gemmingen, G. 2001. **Secondary forests associated with the rehabilitation of degraded lands in tropical Asia: a synthesis**. *Journal of Tropical Forest Science* **13**(4): 816-831. Rehabilitated secondary forests constitute a potential new and emerging resource requiring changes in policy favouring the rehabilitation of the large areas of degraded land in tropical Asia. Conversion of degraded lands into rehabilitated secondary forests rather than into monoculture plantations of exotics may be better for meeting the diverse product needs of local people, other stakeholders, and changing markets, as well as for environmental amelioration. It is also a relatively inexpensive method, suitable for rehabilitation by local people. Government and other stakeholder interest in and scope for rehabilitating degraded lands to secondary forest systems tend to increase along a proposed land use intensification model. Attempts to rehabilitate degraded lands in the intensive exploitation stage because of international pressures or funding availability are often not viable because the underlying socio economic and institutional causes of degradation may continue to operate. In the forest depleted stage, the biophysical and socio economic situation is more ripe for policy changes and implementation favouring rehabilitated secondary forests. The driving forces behind the rehabilitation efforts tend to shift from large scale timber production to local livelihood, more diverse local market and environmental needs coinciding with the depletion of forest resources. However, the development of rehabilitated secondary forests may still be constrained by degraded site conditions, the persistence of chronic disturbances and lack of incentives. Rising international and national commitment to biodiversity conservation, community based management, forest rehabilitation, timber certification and climate stabilisation could as well focus more on secondary forest regeneration and management in protected areas and as community forests, serving both conservation and production goals.

Chokkalingam, U., Smith, J., de Jong, W. and Sabogal, C. 2001. **A conceptual framework for the assessment of tropical secondary forest dynamics and sustainable development potential in Asia**. *Journal of Tropical Forest Science* **13**(4): 577-600. In this paper, authors present an intensification model based on the intensity of exploitation and use of forests and forest lands as a relevant framework for analysing the appearance, dynamics, and evolution of different types of secondary forests. The systematic driving forces responsible for the disturbances and subsequent secondary forest regrowth tend to change and evolve along this continuum. This dynamic, process-oriented, long term framework draws on existing theories and models of the underlying factors of forest change relevant for tropical Asia, and emphasizes factors related to secondary forests. Authors identify and characterize four general stages along this intensification continuum - the extensive use stage, the intensive exploitation stage, the forest depleted stage, and the forest recovery stage. In the extensive use stage, secondary forests tend to be limited and largely arise from long-rotation swidden agriculture. In the intensive exploitation stage, secondary forests tend to increase in absolute and proportional area, and arise mainly out of industrial and local logging activities and fires. In the forest depleted stage, natural forest cover is low and there is increasing interest in forest conservation, reforestation and sustainable management for timber, environmental and

local needs. In the forest recovery stage, there is increased forest cover as a result of reforestation measures or regeneration with land use abandonment. This framework can help guide management and policy options for secondary forests based on threats and relative resource endowments, infrastructure, and the policy and institutional environment present in each stage. It could also be used to identify effective intervention points and to anticipate and prevent problem situations beforehand.

Colfer, C. J. P. and Byron, Y. (eds.). 2001. ***People managing forests: the links between human well-being and sustainability***. Washington, DC, Resources for the Future and Center for International Forestry Research (CIFOR), Indonesia, 447p. This book examines aspects of human well being (identified in earlier research on sustainable forest management) in a variety of contexts. The 26 authors reports results of research conducted in six countries (Indonesia, Brazil, Cameroon, Gabon, Trinidad, and the United States), in conjunction with a series of social science methods tests designed to assess human well being in areas where logging was taking place. These social science results were obtained as part of a project on criteria and indicators for sustainable forest management. This book, comprised of 16 chapters, includes sections focusing on gender and diversity, and a conservation ethic, as well as two principles found important for sustainable forest management: security of intergenerational access to resources, and rights and responsibilities to manage co-operatively and equitably. It includes a chapter looking at geographical and temporal comparisons related to human well being and sustainability.

Colfer, C. J. P., Peluso, N. L. and Ching See Chung. 1997. ***Beyond slash and burn: building on indigenous knowledge in managing Borneo's tropical rain forests***. Bronx, NY, New York Botanical Garden Press. 158p. Community based forestry has the potential to contribute much more to achieving sustainable development and poverty reduction than is the case today. This paper describes and analyzes these potentials and demonstrates their feasibility with real world cases of community forest businesses and innovative policies and business partnerships. This preliminary assessment is offered as a first step in a longer-term effort to understand existing forest product and service markets, and to identify the most promising market opportunities for local community producers, focusing particularly on developing countries. Part I presents the broader context of forestry's changing relation to rural development and poverty reduction. Part II develops a framework for considering which market niches have potential for poor producers. Part III proposes strategies and targeted actions to realize that potential.

De Foresta, H., Michon, G., Kusworo, A. and Levang, P. 2004. **Damar agroforests in Sumatra, Indonesia**: **domestication of a forest ecosystem through domestication of dipterocarps for resin production**. In: Kusters, K. and Belcher, B. (eds.) *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Product Systems, Vol. 1. Asia*, Center for International forestry Research, Indonesia, 207-226 pp. Farmers in the West Lampung Pesisir area in the south of Sumatra, Indonesia, have established forest gardens by introducing damar trees in upland rice swidden plantations. These damar gardens were established as the wild resource itself was vanishing. While cultivating this forest resorce, villagers have achieved the global restoration of a forest in the middle of agricultural lands. Harvest of resin from damar trees represents the main source of household cash income. Furthermore, Pesisir farmers managed to preserve a high level of biodiversity and a whole range of economic products and functions originally derived from the forest. Institutionally, appropriation of the forest resource entailed a total reorganization of the traditional tenure

system for forest lands and goes along with the increasing importance of land as property and privatisation of this property. During the 1990s, the acceleration of regional development has threatened the agroforests area, as they were not recognized by the state and had no legal status. Damar gardens, as a succesful forest management strategy developed by local communities, may represent an important support for the development of formal recognition of local people's rights over forest resources. Average annual income per ha per year from products in mature damar agroforests in Pahmungan village, Central Pesisir subdistrict (data year 1995) comes to US$1106. It ranges between US$750 in no-fruiting season and US$1625 in fruiting-season.

de Jong, W. 1996. **Swidden-fallow agroforestry in Amazonian: diversity at close distance**. *Agroforestry Systems* **34**: 277-290. Swidden-fallow agroforestry among ribereño farmers in the Peruvian Amazon has been reported to show important regional variation. In this paper diversity in terra firme swidden-fallow agroforestry is described for a single village, Santa Rosa, located at the lower Ucayali river, Peru. Local forest gardens differ in managed species composition, weeding patterns, and yield levels. Most of the produce from Santa Rosa forest gardens is locally consumed; only little is traded. Many forest species are actively tended or planted in forest gardens. These systems have the function of suppliers of a range of products. Variation in forest garden management is a result of farmers individual perception of the need for such products.

de Jong, W. 1997. **Developing swidden agriculture and the threat of biodiversity loss**. *Agriculture, Ecosystems & Environment* **62**(2-3): 187-197. Indonesia has the world's third largest area of tropical forest. These forests are treasured for their high biodiversity, a result of the country's unique geographic positioning, but also as an economically important natural resource. Although the early decades of accelerated timber exploitation in Indonesia demonstrated little concern for the sustainability of forest resources, recently a shift to genuine conservationist forest policies can be observed. These new policies, however, mainly relate to the forestry sector and much less to the ongoing conflicts between the state and forest-dependent people. It is still a commonly held belief that swidden agriculturists are responsible for about half of Indonesia's annual deforestation. In order to solve this problem the country has defined a number of measures that attempt to convert swidden agriculturists into sedentary cultivators. In this paper these measures are discussed, and they are juxtaposed to new insights on the nature of the dynamics of swidden agriculture and the role that forest management plays in this agricultural method. The official schemes only propose some sort of plantation development, which significantly reduces biodiversity in the agricultural landscape. With an example of swidden agriculture from West Kalimantan, including it's important forest management component, this paper demonstrates that developing such existing agriculture-forest management holds the potential to bring economic development to the region, while biodiversity is conserved.

de Jong, W. 2001. **Tree and forest management in the floodplains of the Peruvian Amazon**. *Forest Ecology and Management* **150**(1-2): 125-134. This paper discusses different tree and forest management strategies in Yanallpa, a ribereño village located within the Ucayali floodplain, Peru. In this village, studies on tree and forest management were conducted through surveys, participative observation and unstructured interviews with farmers. Farmers in the floodplain rely on a mixed portfolio of agricultural production, including tree and forest management. Fields in which tree or forest management occurs are of two types: forest gardens in which a large number of species are being produced, and

fields in which annual crops are combined with one or several tree species. Within each of these two categories distinctive tree or forest management strategies are recognized. In forest gardens, tree production is the main economic activity. On agricultural fields especially in the lower elevations that have the more fertile soils, trees may be grown in addition to annual or semi-perennial crops. Two species, *Cedrela odorata* and *Calycophyllum spruceanum* are prominently managed in the latter field types. It appears, however, that the specific tree composition of fields is closely related to the alternative options of crop-production on those fields. These alternative options are largely related to the biophysical conditions of these fields. Tree and forest management appears to be an appropriate option as part of floodplain agriculture, but options have to be adjusted to the specific circumstances that different sites offer.

de Jong, W., Chokkalingam, U. and Perera, G.A.D. 2001. **The evolution of swidden fallow secondary forests in Asia**. *Journal of Tropical Forest Science* **13**(4): 800-815. Swidden agriculture in tropical Asia is a diverse practice, making it difficult to draw general conclusions on trends of the development of swidden fallow secondary forests (SFSF). There is, however, sufficient evidence to recognise trends of a gradual intensification often through the incorporation of extensive tree crop production in SFSF, or a direct conversion to intensive tree cash cropping. Factors contributing to the changes include emerging markets for cash crops or timber and pulp wood production, government policies and development projects, fire, and population pressures. In Indonesia and mainland Southeast Asia, there is evidence of change towards tree and cash crop based production systems. In northeastern India, there is improved fallow management to sustain or enhance productivity of the shortened swidden agricultural cycle to support a subsistence economy. In Sri Lanka, biophysical factors inhibit the development of intensive agroforestry systems. Although swidden fallow land use has often been stigmatised as leading to forest decline and a related decline in the environmental functions that forests provide, there is sufficient evidence suggesting that conversion of a SFSF dominated landscape to more intensive tree cropping can have a negative environmental impact. Some general options for the evolution of swidden agriculture under different stages of a land use intensification model are considered.

de Jong, W., Chokkalingam, U., Smith, J. and Sabogal, C. 2001. **Tropical secondary forests in Asia: introduction and synthesis**. *Journal of Tropical Forest Science* **13**(4): 563-576. Paper provides a brief overview of secondary forests in Asia: their diversity, importance and role in future environmental management, and the renewed attention to tropical secondary forests. The paper introduces two analytical tools to better understand the current situation and trends of secondary forests in Asia: a typology of tropical secondary forest in Asia, and a conceptual framework that explains the formation and dynamics of these forests. It also provides recommendations for actions and needs for future research.

de Jong, W., Freitas, L., Baluarte, J., van de Kop, P., Salazar, A., Inga, E., Melendez, W. and Germaná, C. 2001. **Secondary forest dynamics in the Amazon floodplain in Peru**. *Forest Ecology and Management* **150**(1-2): 135-146. Studies in secondary forest in Latin America have largely been confined to terra firme lands. This paper reports on a study of dynamics of secondary forest and its interactions with land use for agriculture and utilization of primary forest in the floodplains of the Ucayali and Amazon rivers in Peru. This environment is marked by more fertile soils than generally found on terra firme lands. Floodplain soils may flood yearly or once every several years. Farmers grow combinations of crops on different agricultural sites, and under annul production and multi-annual regimes. Secondary forest

plays and important role in this environment. The main trends in the process of formation of secondary forest have been analyzed through a survey among 218 farmers, collecting data on land use, primary and secondary forest management, and other economic activities. The results show that processes of secondary forest formation are influenced by advancing market access, changes in the dominant land type as a result of river floods, and population pressure when villages become older. As villages age farmer's holding tend to become smaller. While this happens, private primary forest reserves are replaced by secondary forest, but total forest cover does not decline. The economic importance of secondary forest increases when these forests age, but improved market access seems to off-set this trend. The concept of frontier expansion, and the related change of the role of secondary forest in the landscape, typical for colonization areas, does only partly apply to this environment.

Delègue, M.-A., Fuhr, M., Schwartz, A.M. and Nasi, R. 2001. **Recent origin of most of the forest cover in the Gabon coastal area**. *Oecologia* **129**(1): 106-113. Variations in the natural 13C abundance of soil organic matter (SOM) at different depths combined with SOM radiocarbon dating were used to reconstruct the history of the forest-savanna successions over the last millennium in the Gabon coastal area. A chronosequence was established by comparing the '13C profiles and the radiocarbon dating of a Gabon savanna with those of a Congolese savanna where the palaeoenvironments are already well known. The palaeoclimatic histories of the two savannas were shown to be strictly identical. The whole Gabon coastal area may well have been forested during the early Holocene, until about 4,000 years ago. The forest fragmented after this initial expansion. Savanna appeared circa 3,000 years ago but the forest did not disappear totally. A new forest transgression started 500-1,000 years ago and expanded over the open areas previously created or enlarged. The marked savanisation and the subsequent and currently ongoing forest expansion explain both the present forest-savanna mosaic and the abundance of secondary species such as Aucoumea klaineana in the coastal forest. Anthropogenic activities over the past decades and centuries have induced local fluctuations in the forest cover, superimposed on the climatic forest-savanna dynamic. This study also confirms that the monospecific, even-aged A. klaineana stands present in the area became established on abandoned cultivation clearings.

Dennis, R., Hoffmann, A., Applegate, G., Gemmingen, G. von and Kartawinata, K. 2001. **Large-scale fire: creator and destroyer of secondary forests in Western Indonesia**. *Journal of Tropical Forest Science* **13**(4): 786-799. Large-scale, catastrophic fires have become a significant and visible part of the tropical forest landscape in the past two decades with increased commercial exploitation of forests, forest conversion and increased population pressure. Secondary forests are an increasingly prominent feature of tropical landscapes and fires play a significant role in both the creation and destruction of these forests. In the past two decades large-scale forest fires have become more frequent in the moist tropics. In addition to climatic factors, the nature of tropical forests appears to be changing and becoming, as a consequence, more predisposed to burning. Secondary forests arising from intensive logging, in particular those that are in a degraded condition, are particularly vulnerable to repeated burning and further degradation. There has been limited general success in fire prevention and rehabilitation of secondary forests affected by fire. In addition, forest policy is not yet sufficiently attuned to address the management needs of the ever-increasing area of secondary forests affected by or developing following fire. Little is known about the exact extent and economic value or potential of post-fire secondary forests in Asia. It is clear, however, based on the experience of the past two decades, that there has been a significant increase in secondary forest affected by fire, particularly in Indonesia. Rough

estimates for Indonesia infer that there could be as many as 5 million ha of post-fire secondary forests following the 1997-98 fires. Based on this knowledge alone, it would seem that post-fire secondary forest is already an important forest type that will provide important goods and services both to the environment, the state and local communities alike, as the area of primary forest diminishes through over-exploitation and conversion.

du Toit, J. T., Walker, B. H and Campbell, B. M. 2004. **Conserving tropical nature: current challenges for ecologists**. *Trends in Ecology & Evolution* **19**(1): 12-17. Tropical biodiversity continues to erode unabated, which calls for ecologists to address the problem directly, placing less reliance on indirect interventions, such as community-based development schemes. Ecologists must become more assertive in providing scientifically formulated and adaptively managed interventions, involving biodiversity payments, to serve local, regional and global interests in tropical nature. Priorities for tropical ecologists thus include the identification of key thresholds to ecological resilience, and the formulation of clear monitoring protocols and management strategies for implementation by local resource managers. A particular challenge is to demonstrate how nature reserves contribute to the adaptive capacity of regional land-use matrices and, hence, to the provision of sustainable benefits at multiple spatial and temporal scales.

Dykstra, D. P.; Heinrich, R. 1996. ***FAO model code of forest harvesting practice***. Rome, Food and Agriculture Organization. 85p.

Edmunds, D. and Wollenberg, E. (eds.) 2003. ***Local Forest Management: the Impacts of Devolution Policies***. London, Earthscan Publications. xvi, 208p. Local government is built around careful and illuminating case studies of the effects of devolution policies on the management of forests in several Asian countries. The studies demonstrate that devolution policies - contrary to the claims of governments - have actually increased governmental control over the management of local resources, and a lower cost to the state. The controversial findings show that if local forest users are to exercise genuine control over forest management, they must be better represented in the processes of forming, implementing and evaluating devolution policies. In addition, the guiding principle for policy discussions should be to create sustainable livelihoods for local resource users, especially the poorest among them, rather than reducing the cost of government forest administration.

Edmunds, D. and Wollenberg, E. 2001. **A strategic approach to multistakeholder negotiations**. *Development and Change* **32**(2): 231-253. Environment and development practitioners increasingly are interested in identifying methods, institutional arrangements and policy environments that promote negotiations among natural resource stakeholders leading to collective action and, it is hoped, sustainable resource management. Yet the implications of negotiations for disadvantaged groups of people are seldom critically examined. Authors draw attention to such implications by examining different theoretical foundations for multistakeholder negotiations and linking these to practical problems for disadvantaged groups. Authors argue that negotiations based on an unhealthy combination of communicate rationality and liberal pluralism, which underplays or seeks to neutralize differences among stakeholders, poses considerable risks for disadvantages groups. It is suggested that negotiations influenced by radical pluralist and feminist post-structuralist thought, which emphasize strategic behaviour and selective alliance-building, promise better outcomes for disadvantaged groups in most cases, particularly on the scale and in the historical contexts in which negotiations over forest management usually take place.

Foote, A.L., Krogman, N.T., Grundy, I.M. , Nemarundwe, N., Campbell, B.M., Gambiza, J. and Gibbs, L.. 2004. **Ilalla Palm (*Hyphaene petersiana*) use in southern Zimbabwe: social and ecological factors influencing sustainability**. *Forest, Trees and Livelihoods* **13**(4): 275-296.

Fredericksen, T. S. and Pariona, W. 2002. **Effect of skidder disturbance on commercial tree regeneration in logging gaps in a Bolivian tropical forest**. *Forest Ecology and Management* **171**(3): 223-230. The impact of skidder disturbance on recruitment of commercial tree regeneration within logging gaps was studied using paired scarified and unscarified plots as well as whole-gap surveys of scarified and unscarified areas in a Bolivian tropical humid forest. More than a year following gap creation, variability in the density of regeneration among logging gaps was high, but commercial tree regeneration density tended to be greater in scarified areas than in unscarified areas within gaps for most species. Height growth was also significantly greater for trees in scarified compared to unscarified areas, despite a near doubling of soil compaction in scarified areas. The principal species benefiting from soil disturbance by skidders was *Schizolobium amazonicum*, which had nearly 10× higher density and 2× greater height growth in scarified compared to unscarified areas. Although initially devoid of vegetation and litter cover, scarified areas had vegetation and litter cover levels similar to unscarified areas after 7 months. Vegetation cover on scarified areas tended to be dominated by early successional tree species while unscarified areas were dominated by forbs and grasses.

Fredericksen, T. S. and Putz, F. E. 2003. **Silvicultural intensification for tropical forest conservation**. *Biodiversity and Conservation* **12** (7): 1445-1453. Minimizing the deleterious environmental impacts of logging and other silvicultural treatments is the primary conservation goal in tropical forests managed for timber production. While it is always environmentally beneficial to minimize unnecessary damage, more intensive silviculture should not be discouraged in tropical forests in which regeneration and growth of commercially valuable timber species requires such treatments. Failing to regenerate commercial species may render forests more susceptible to conversion to other, more lucrative land uses. Increasing the intensity of silviculture may also decrease the total area of forest exploited for timber, thereby reducing the impacts of over-hunting, timber theft, wildfires, colonization, and conversion, which are facilitated by the increased accessibility of logged areas.

García-Fernández, C. 2004. **Benzoin, a resin produced by Styrax trees in North Sumatra Province, Indonesia**. In: Kusters, K. and Belcher, B. (eds.) *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Product Systems, Vol. 1. Asia*, Center for International forestry Research (CIFOR), Indonesia, 151-168 pp. Sumatran benzoin is a resin produced by Styrax trees, managed in forest gardens in the highlands of North Sumatra. The resin is used in incense, perfume and pharmaceutical preparations and as a flafouring agent. Trade with foreign countries has existed for over a millennium, first with China and later with Arab and Europe. The economic and cultural roles of benzoin have undergone major changes in the last few decades. Previously benzoin gardening was considered a high status activity which generated high incame and made farmer proud. Nowadays some villages have abandoned the practices as other more profitable cash crops have displaced benzoin as an income source. The younger generations perceives benzoin cultivation as a backward activity, preferring to work in their annual crop gardens or for wages. Nevertheless some farmers remain attached to benzoin as they recognize it as the product that gave life to their

settlement and provided the means to educate generations of relatives. From a conservation point of view, benzoin management represents low-intensity disturbance of the ecosystem and allows the effective accumulation of a forest species while maintaining the forest environment. The contribution of *benzoin* to household income can range between 30% and 45%. The middle income groups have an average annual household income of US$482 and *benzoin* contribution ranges fromUS$144 to US$216.

García-Fernández, C., Casado, M. A. and Ruiz Pérez, M. 2003. **Benzoin gardens in North Sumatra, Indonesia: effects of management on tree diversity**. *Conservation Biology* **17**(3): 829-836. In recent years, research on tropical forest conservation has increasingly focused on traditional management systems as a means of achieving a balance between conservation and development. *Styrax paralleloneurum*, a forest-canopy tree species that produces benzoin, an aromatic resin, is cultivated in such a system. This study is an attempt to determine the impact of benzoin garden management on forest structure, species composition, and diversity. Forty-five gardens were chosen for study in two Northern Sumatra villages, where data on management practices and ecological structure were gathered. Ecological information was also collected from abandoned benzoin gardens and primary forest areas for purposes of comparison. Although benzoin management requires that competing vegetation be thinned, these activities are not intensive, allowing species that coppice to remain in the garden and thereby reducing the effects of competitive exclusion mechanisms on species composition. Tree species diversity in abandoned gardens was similar to that in primary forest, but endemic species and species characteristic of mature habitats were less common. Traditional benzoin garden management represents only a low-intensity disturbance and maintains an ecological structure that allows effective accumulation of forest species over the long term.

Garrity, D. P. 1999. **Contour Farming Based on Natural Vegetative Strips: Expanding the Scope for Increased Food Crop Production on Sloping Lands in Asia**. *Environment, Development and Sustainability* **1** (3-4): 323-336. In the agriculture of the future, there is a compelling place for agroecologically-based practices alongside practices based on the best available chemical, genetic, and engineering components. This paper explores this issue in the context of the development and spread of a conservation farming system based on natural vegetative contour buffer strips in smallholder production systems in southeast Asia. Farmers adapted contour hedgerow farming practices into a simpler, buffer-strip system as a labor-saving measure to conserve soil and sustain yields on steeply sloping cropland in Claveria, Mindanao, Philippines. Permanent-ridge tillage systems were also adapted to smallholder farming systems by researchers. Natural vegetative buffer strips resulted in gradually increasing yields, with an estimated benefit of 0.5 t/ha/crop. They were seen to increase land values, facilitate investment in more intensive and profitable cropping systems, and expand the land base for food crop agriculture. They induced an institutional innovation of farmer-led Landcare organizations, which have spread this and other agroforestry practices to thousands of households in the southern Philippines.

Gautam, K. H. 2004. **Lapsi (*Choerospondias axillaris*) emerging as a commercial non-timber forest product in the hills of Nepal**. In: Kusters, K. and Belcher, B. (eds.) *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Product Systems, Vol. 1. Asia*, Center for International forestry Research (CIFOR), Indonesia, 117-132 pp. Lapsi (*Choerospondias axillaris*) tree is traditionally grown by farmers in the hill agroecosystems of Nepal. The study conducted in Sindhupalchok and Kavrepalanchok

districts notes that average number of trees of any species on farmlands is 33 per household and Lapsi accounts for 36% of these. It is estimated that 10-30% of people living in the area use Lapsi fruits for commercial purposes. The average annual income from the sale of lapsi fruit is US$14.30 per tree, and ranges from US$1.60 to US$32.10 (year 1996).

Ghazoul, J., Liston, K.A. and Boyle, T.J.B. 1998. **Disturbance-induced density-dependent reproductive success in a tropical forest tree**. *Journal of Ecology* **86**(3): 462-473. The reproductive output of Shorea siamensis, a widespread dipterocarp tree, was assessed in relation to disturbance and tree density at three sites in western Thailand during the 1996 and 1997 flowering seasons. The locations were similar except in disturbance history, which was reflected in decreasing tree density from undisturbed via moderately disturbed to disturbed sites. Hand pollination experiments showed S. siamensis to be partially self-incompatible due to differential pollen tube growth and abortion of inbred fruit. Although more than 90% of flowers from trees at all sites were pollinated, pollen tubes developed in only a small proportion of these flowers. Both pollen tube development and initial fruit production were highest at the undisturbed site. Many fruit, presumably selfed, were aborted during development at all sites, but significantly more fruit were aborted at the disturbed site, resulting in lowered production of mature fruit. S. siamensis was pollinated by small Trigona bees, which exhibited significant declines in intertree movements with increasing distance between flowering trees. As resource availability did not differ between sites, differences in mature fruit set were considered to be mediated by changes in pollinator foraging behaviour at different tree densities. Variation in seed set was negatively correlated with distance to nearest conspecific both within and between sites. At the two least disturbed sites observed seed set values corresponded with those expected by calculation. However, seed set at the disturbed site was significantly lower than expected. The results suggest that high reproductive success of S. siamensis is dependent upon cross-pollination, which, through pollinator behaviour, is a function of tree isolation. This species may thus be subject to the Allee effect, where population viability is reduced disproportionately with a decline in population size or population density.??

Gregersen, H., Lundren, A.and Byron, R.N. 1998. **Forestry for sustainable development: making it happen**. *Journal of Forestry* **96**(3): 6-10. Sustainable development is a process of meeting the continuing, evolving needs of people while protecting and enhancing the resource base on which all production of goods and environmental services depends. Good forest management is an essential part of the sustainable development process. Given the need to share the benefits from forests, and given the uncertainty adaptive management approach is needed, one that lets us most easily adapt if we find in the future that we are on a path of sustainable development.

Guariguata, M. R. 1998. **Response of forest tree saplings to experimental mechanical damage in lowland Panama**. *Forest Ecology and Management* **102**(2-3): 103-111. Physical damage to saplings is considered an important factor that affects tree population dynamics in tropical forests, but interspecific differences in post-damage vegetative recovery and survival have been rarely quantified. Over 4 years, the vegetative and demographic responses to experimental mechanical damage were monitored in naturally-growing saplings of four coexisting tree species, under comparable overhead illumination conditions, in a lowland moist forest in Central Panama. Inflicted damage mimicked both crown loss and stem breakage (‘snapped’) and stem pinning by fallen debris (‘bent’) in individuals (1.0-2.5 m tall) of *Alseis blackiana* (Rubiaceae), *Protium panamense, P. tenuifolium*, and *Tetragastris*

panamensis(all Burseraceae). For all species combined, 4-year percent mortality was significantly different between bent (21%), snapped (13%), and undamaged controls (6%). Species differed in their capacity to survive damage. Saplings of *A. blackiana* showed the highest resilience, expressed as a high ability to regain pre-damage height in snapped individuals, production of adventitious roots in bent individuals, and very high survival. A previous classification of the study species fit them into a large 'generalist' guild, after no illumination preferences were obvious for their juvenile growth and survival at the study site. In contrast, this study suggests that tree vegetative behavior should be incorporated in future tropical forest research that attempts to detect species differentiation in regeneration potential at the sapling phase.

Guariguata, M. R. 1999. **Early response of selected tree species to liberation thinning in a young secondary forest in Northeastern Costa Rica**. *Forest Ecology and Management* **124**(2-3): 255-261. Short-term growth responses in individuals of four commercial tree species (*Laetia procera*, *Simarouba amara*, *Tapirira guianensis*, and *Vochysia ferruginea*) were evaluated one and two years after `liberation thinning' in a young (4.5-year-old), dense secondary forest stand located in an agricultural settlement in wet, Northeastern Costa Rica. Liberation thinning involved manual elimination (either by cutting or stem girdling) of the adjacent `ring' of competitors in order to release future crop trees (median diameter: 8 cm DBH), selected on the basis of stem and crown form. The application of liberation thinning significantly increased diameter growth of future crop trees with respect to unmanipulated counterparts. Young stands in the region may be attractive systems for simple silvicultural manipulations due to rapid growth responsiveness, facilitated by manageable tree size. Detailed observations on stand development and patterns of crown stratification in coexisting tree species in other dense secondary stands in the area seems warranted in order to refine silvicultural options aimed at increasing tree diameter growth.

Guariguata, M. R. 2000. **Seed and seedling ecology of tree species in neotropical secondary forests: management**. *Ecological Applications* **10**(1): 145-154. In this paper author describes interspecific patterns of seed longevity in the soil, germination, and survival and growth of transplanted seedlings under closed canopy of nine tree species that are common in secondary forest stands in wet, lowland Costa Rica and most of which are timber species in the region: *Cordia alliodora*, *Hampea appendiculata*, *Jacaranda copaia*, *Laetia procera*, *Rollinia microsepala*, *Simarouba amara* [*Quassia amara*], *Stryphnodendron microstachyum*, *Trichospermum grewiifolium*, and *Vochysia ferruginea*. Many of these species also occur throughout the lowland neotropics. Experiments were carried out in three replicate secondary-forest stands (20-30 yr old after pasture abandonment) located at La Selva Biological Station in northeastern Costa Rica. Longevity of experimental seed cohorts differed markedly among species, from <3 mo (*Cordia*, *Hampea*, *Simarouba*, *Vochysia*), to >1 yr (*Stryphnodendron*). Similarly, germination of recently dispersed seeds in the understory ranged from 0% in *Laetia* to >75% in *Cordia* and *Vochysia*. In contrast, seedling survival was uniformly low (<10% survival one year after transplanting except for *Stryphnodendron*, which showed approx equal to 20% survival). The implications of these findings for the management of secondary forest stands for timber production are varied and depend on the species of interest. First, all study species appear to require nearly complete canopy opening to regenerate as they show limited capacity either to germinate or to survive as seedlings in the understory. Second, some species that can germinate at high levels in the shade can be managed at the seedling stage by opening up the canopy a few months after germination (e.g., *Cordia*, *Simarouba*, *Vochysia*). Third, species that show little or no germination under closed

canopy (e.g., *Jacaranda*, *Laetia*, *Rollinia*) will need canopy removal simply to germinate in adequate amounts. Due to rapid declines in seed viability and seedling survivorship, however, any canopy manipulation must be performed not beyond 6 mo in order to guarantee adequate levels of soil-stored seeds or seedlings for future stand development. Site-preparation techniques may need implementation, given the potential of competing vegetation to interfere with seedlings after canopy opening, as suggested by the high abundance of herbs and shrubs present in the soil seed bank in the study stands. Finally, the results of this study suggest that ecological classifications of trees solely based on light preferences for stem growth may fail to account for important differences among species in their regeneration mode.

Guariguata, M. R. and Pinard, M. A. 1998. **Ecological knowledge of regeneration from seed in neotropical forest trees: Implications for natural forest management**. *Forest Ecology and Management* **112**(1-2): 87-99. Authors discuss the main ecological factors that influence tree recruitment in neotropical moist- and wet forests within the context of timber management based on selective logging. They argue that setting aside protection areas in managed forests as a way to preserve ecological processes may not be sufficient to ensure sustainable levels of tree regeneration, and that a thorough understanding and application of tree seed ecology can help to refine management prescriptions. Authors review relevant aspects of tree reproductive biology, seed production and dispersal, spatial and temporal constraints on seed availability, disperser behavior, and the potential consequences of hunting and forest fragmentation on tree regeneration, and discuss their implications for biological sustainability in managed forests. Tree seed production can be influenced by the selective removal of neighbors of the same species (due to insufficient pollen transfer), flowering asynchrony, and attributes of the species' sexual system. The extent to which an area is supplied by seed can be affected by dispersal mechanism, spatio-temporal limitations to seed dispersal, and tree size-dependent levels of seed production at the species level. Studies of vertebrate-disperser behavior and tree seed deposition in logged forests are scarce and warrant further attention in order to refine our understanding of the dependency of sustained timber production on vertebrate fauna. Although much remains to be learned about tree seed ecology in neotropical logged forests, the baseline information presented here may offer a starting point for developing ecological criteria for seed tree retention. Furthermore, it may contribute in improving ecologically-based management prescriptions in order to enhance or at least maintain sufficient levels of natural regeneration without the need to rely on artificial regeneration.

Guariguata, M. R.; Rheingans, R.; Montagini, F. 1995. **Early woody invasion under the tree plantation in Costa Rica: implications for forest restoration**. *Restoration Ecology* **3**(4): 252-260.

Guariguata, M.R. 1998. **“Natural” forest management and biodiversity conservation**. *Conservation Biology* **12**(5): 941-941.

Guariguata, M.R., Manuel, R. and Dupuy, J.M. 1997. **Forest regeneration in abandoned logging roads in lowland Costa Rica**. *Biotropica* **29**(1): 15-28. This study characterised plant regeneration in four old logging roads (700-1 000 m long) in selectively logged forests in lowland Costa Rica, 12-17 years after abandonment. Sets of 4 m2 plots were laid out at 20 m intervals in three distinct microhabitats: road track (topsoil eliminated), road edge (where removed topsoil accumulates on the sides after road construction), and adjacent logged forest. Density of stems taller than 1 m and at least 5 cm dbh (included canopy trees, midstorey

trees, lianas, palms, shrubs and tree fern species) was highest in the road edge plots than either the track or logged forest plots. This 'edge effect' is presumably due to buried seed germination of light-demanding trees and shrubs after moderate soil disturbance, less compaction and higher substrate fertility than in road tracks. Species richness was the lowest, but relative dominance the highest, in the track plots of all roads: 6-9 species comprised alone 50% of the Importance Value Index (IVI), in contrast to 11-15 and 16-22 species required to reach 50% IVI in edge and forest plots, respectively. There was evidence of soil compaction in tracks in three out of four roads which, in addition to low substrate fertility and initial lack of on-site plant propagules, could explain slower recovery of stem density and species richness compared to edge and logged forest plots. For stems between 5 20 cm dbh, density and basal area in the track plots averaged about one-fourth of edge and logged forest plot values. Authors estimated recovery of basal area in road tracks to take at least 80 years to reach the status found in logged forest, and species richness over an even longer period. Authors suggest that abandoned logging roads serve as long corridors of relatively uniform and long-la sting floristic and structural characteristics that may confer particular ecological roles in selectively logged forests.

Hackett, C. and Vanclay, J. K. 1998. **Mobilizing expert knowledge of tree growth with the PLANTGRO and INFER systems**. *Ecological Modelling* **106**(2-3): 233-246. PLANTGRO can provide estimates of plant and tree growth under a wide range of conditions by evaluating responses to some 20 environmental variables ranging from day length to soil pH and determining the limiting factor. Although intended only to indicate the suitability of a given site-species combination, empirical trials suggest that the suitability index provides a reasonable indication of growth potential, offering correlations with height growth as high as 80%. PLANTGRO can be calibrated for new situations by providing appropriate soil, climate and species files. These can be compiled from plot-based data, casual observations, or expert knowledge. INFER is an expert system which complements PLANTGRO by providing an objective framework to elucidate plant growth details from casual observations. Together, INFER and PLANTGRO offer an effective way to provide initial growth estimates for species-site combinations not covered by plot data or other models. PLANTGRO is available from C. Hackett, and INFER and many PLANTGRO files for forest trees may be accessed on the internet at http://www.cgiar.org/cifor/research/tropis/PLANTGRO.html

Hartanto, H., Lorenzo, M.C.B. and Frio, A.L. 2002. **Collective action and learning in developing a local monitoring system**. *International Forestry Review* **4**(3): 184-195. One of the challenges the communities face when managing forests is the lack of a systematic and transparent monitoring system that can be used to monitor their resource management strategies and to communicate their successes to outsiders. This paper argues that monitoring efforts will be sustainable only if the system had been developed by the communities in collaboration with other relevant stakeholders with an aim of enhancing their learning and understanding rather than for compliance purposes. This paper describes the processes used by a People's Organisation in Palawan, Philippines, in developing their monitoring system with the support of several key stakeholders. The processes include the development of the monitoring framework, negotiation on how to collaborate in this effort, and the development of monitoring arrangements (including who collects data, what data to collect, and how to collect it). It shows how the development processes brought different community groups and stakeholders with different interests, objectives, and mandates together for collective action and learning.

Hartanto, H., Prabhu, R., Widayat, A. S. E. and Asdak, C. 2003. **Factors affecting runoff and soil erosion: plot-level soil loss monitoring for assessing sustainability of forest management**. *Forest Ecology and Management* **180**(1-3): 361-374. The assessment on key ecological factors affecting runoff and soil erosion and the usefulness of plot-level monitoring of soil erosion was conducted by collecting runoff and soil loss records from 14 runoff plots. The runoff plots were set up in two catchments in Central Kalimantan, Indonesia, where conventional logging and Reduced Impact Logging (RIL) took place. Runoff plots were set up in forest areas with different levels of logging disturbances, i.e. harvesting areas (four plots), skid trails (six plots), and undisturbed/control areas (four plots). The magnitude of runoff and soil loss from skid trail plots were found to be the highest, followed by control plots and harvest plots. Canopy cover, sapling density, litter depth and woody debris appeared to be important ecological factors that determine the magnitude of soil loss. Tree canopy determines the size and erosive power of the raindrops. Sapling, litter layer, and woody debris protected soil surface, thus preventing soil detachment, and provided surface roughness that minimised soil particle movement down the slope. The roles of these ecological factors were less significant compared to rainfall in determining the magnitude of runoff. Canopy cover, sapling density, litter depth and woody debris can be measured quantitatively or qualitatively without complicated equipment and methods. Furthermore, they are sensitive to logging disturbance which make them suitable verifiers of soil erosion. Forest managers need to limit disturbance to these factors in order to minimise soil erosion in their logging operation areas. Monitoring of soil loss using runoff plots was cost-effective and provided valuable information about soil erosion risks caused by logging operations. Runoff plots clearly demonstrated site disturbances where the plots are located. Monitoring allowed more direct linkages to be made between management practices and their impacts on runoff and soil erosion, thereby enabling forest managers to identify problems and take appropriate preventive measures to improve their management practices

Ilstedt, U., Malmer, A., Nordgren, A and Liau, P. 2004. **Soil rehabilitation following tractor logging: early results on amendments and tilling in a second rotation Acacia mangium plantation in Sabah, Malaysia**. *Forest Ecology and Management* **194**(1-3): 215-222. Timber extraction with crawler tractors in humid tropical forests causes degradation of soil physical properties and decreases plant growth. Authors tested rehabilitation of tracks in a second rotation *Acacia mangium* plantation in Sabah, Malaysia, by tilling with additions of NPK-fertilizer, ash and organic material to a depth of 15–20 cm. Two years after planting total basal area of *A. mangium* seedlings was 62% higher outside tracks compared to unimproved tracks, while on NPK-fertilized tracks performance was 700% higher compared to unimproved tracks. Corresponding figures for average height were 40 and 80%. After 8 days with little rain track topsoil experienced water shortage with all studied soil improvements. For 'non-tracked' areas wilting-point (−1500 kPa) was not reached during 17 days of dry weather, and more meso-pores were present. Consequently, depending on rainfall after planting the effect of soil rehabilitation on tree performance may be less positive than shown here, because dry periods of 2 weeks length are common in the humid tropics. Bulk density on plots outside tracks in this second-generation plantation was 60% higher than have been reported in similar first-generation plantations. It is discussed that this might be a warning that repeated logging and fire may have a detrimental effect on soil physical properties.

Iskandar, H., Hubble, D. L. and MacDicken, K. G. 2003. **Estimating dbh of commercial trees from stump measurements in Malinau, East Kalimantan**. *Journal of Tropical*

Forest Science **15**(3): 502-504. This paper presents diameter at breast height prediction models for commercial dipterocarps, commercial non-dipterocarps and a general model for all commercial trees in the Malinau district in East Kalimantan, Indonesia.

ITTO. 2002. ***ITTO guidelines for the restoration, management and rehabilitation of degraded and secondary tropical forests***. Yokohama, Japan, ITTO, CIFOR, FAO, IUCN, WWF International. ITTO Policy Development Series. No. 13. 84p.

Jennings, S.B., Brown, N.D. and Sheil, D. 1999. **Assessing forest canopies and understorey illumination: canopy closure, canopy cover and other measures**. *Forestry* **72**(1): 59-73. The forest canopy is one of the chief determinants of the microhabitat within the forest. It affects plant growth and survival, hence determining the nature of the vegetation, and wildlife habitat. A plethora of different techiques have been devised to measure the canopy. Evaluation of the literature reveals confusion over what is actually being measured. This paper distinguishes two basic types of measurement: canopy cover is the area of the ground covered by a vertical projection of the canopy, while canopy closure is the proportion of the sky hemisphere obscured by vegetation when viewed from a single point. The principal techniques used to measure canopy cover, canopy closure, and a number of related measures are described and discussed. The advantages and limitations are outlined and some sampling guidelines are provided. The authors hope to clarify the nature of the measurements and to provide foresters with sufficient information to select techniques suitable for their needs.

de Jong, W., Campbell, B. M. and Schröder, J. M. 2000. **Sustaining incomes from non timber forest products: introduction and synthesis**. *International Tree Crops Journal* **10**(4): 267-275. Among the reasons why an income that people get from any given non-timber forest (non-wood) product (NTFP or NWFP) can decline are over-harvesting of the resource base, capturing of the business by local elite, domestication of the product, decreased demand, or manufacturing of substitutes. In all of these scenarios, income for local collectors is likely to diminish or disappear altogether. This special issue of the International Tree Crops Journal brings together a number of studies from Bolivia, Peru, Zimbabwe and Cameroon assessing the sustainability of incomes from non-timber forest products once their commercialization has already been achieved. The studies conclude that avoiding over-harvesting of a commercially successful forest product will in most cases require some restraints on harvesting, usually through developing rules and regulations at the appropriate level. These institutional arrangements are also needed to avoid exclusive income capturing by powerful elites. Sustained production can also be achieved through intensified management or cultivation. Maintaining market demand requires constant marketing effort, or adjusting the products that are supplied to different demands. Even so, there is always the possibility that commercially successful forest products will be replaced by others that provide a higher consumer satisfaction or are produced more efficiently. A constant effort is thus needed to develop new products, for which the entire production and marketing may have to be set up.

de Jong, W. 2000. **Micro-differences in local resource management: the case of honey in West Kalimantan, Indonesia**. *Human Ecology* **28**(4): 631-639. Two cases of honey procurement involving *Apis dorsata* bees in the province of West Kalimantan, Indonesia are described. The first case examines the honey tree management among the Maté-Maté Dayak in Sanggau, while the second case discusses the beekeeping process by Malay in Danau Sentarum lake area, in the district of Kapuas Hulu. Sets of rules regulating the access to the

trees and the nesting sites and the appropriate fines imposed by the beekeepers of the two regions are also presented. It is indicated that by working to increase the monetary income of the honey industry, the issues of providing the people with sufficient livelihood and the preservation of the environment can be met. Honey exploitation as a means to increase income, however, is not an option among the Maté-Maté Dayak because of low yields. An Indonesian-German Social Forestry Development Project aiming to reforest *Imperata cylindrica* or other fallow lands tries to address this issue.

Kaimowitz, D. 1996. **The political economy of environmental policy reform in Latin America**. *Development and Change* **27**(3): 433-452. Factors affecting the likelihood of different environmental policy reforms in Latin America are analysed, with particular emphasis on: the strengths and weaknesses of different groups which promote such reforms; the degree to which the reforms are compatible with the region's current economic policies; and how the type of political regime affects these issues. It is concluded that, although there has been progress in recent years, the possibility of carrying out far-reaching reforms which could substantially reduce pollution and resource depletion has been limited by: (1) the difficulties involved in linking environmental issues with concerns for social justice; (2) economic policies which promote the exploitation of natural resources and labour and weaken the public sector; and (3) the great influence over regional governments of groups with vested interests in continuing environmentally destructive activities.

Kaimowitz, D. 1997. **Factors determining low deforestation: the Bolivian Amazon**. *Ambio* **28**(8): 537-540. Determinants of low deforestation in Bolivia are analysed, based on the Bolivian experience and general deforestation literature, and lessons are drawn for other countries with low deforestation. Weak domestic demand for agricultural products and poor transportation infrastructure are the principal causes of low deforestation. Weak domestic demand is related to small population and low per capita income, and poor transportation infrastructure is a function of a country's low capacity for investment in infrastructure and political factors. Production for export plays an important role in deforestation in these contexts, and is influenced by policies such as road building, appreciated exchange rates and subsidies for commercial agriculture. Factors influencing land clearing by poor families are less relevant. Political and institutional factors deserve greater attention than they have received in previous deforestation literature.

Kaimowitz, D. 2000. **Forestry assistance and tropical deforestation: why the public doesn't get what it pays for**. *International Forestry Review* **2**(3): 225-231. Popular concern about tropical deforestation largely drove the rapid growth in forestry assistance in recent years. Nevertheless, forestry assistance has had limited impact on forest clearing and much of it has gone to address other problems. To reduce inappropriate deforestation requires a combination of a multi-sectoral approach, greater regulation, and payment for environmental services. Aid officials have been partially unwilling and partially unable to adopt these approaches. They have also been reluctant to clarify public misconceptions about deforestation and to devote their energy to convincing the public to support forestry assistance for purposes other than forest preservation.

Kaimowitz, D. 2002. Toward a pro-poor forest science. *IDS Bulletin* **33**(1): 123-126. Two distinct visions of tropical forests co-exist in the scientific literature. One is more neo-Malthusian. The other is more pro-poor. The evidence increasingly favours the latter, although many uncertainties remain. The pro-poor literature emphasises that poor families

create and manage forests as well as destroy them, that the forests and the communities have evolved together, and that many forestry regulations and conservation initiatives hurt the poor without helping the forest. For those that support a more pro-poor vision, the challenge is to find ways to reach broader audiences with their message. That will require communicating in ways people can relate to and convincing them that they and the rural poor share many common interests.

Kaimowitz, D. 2002. **Towards a pro-poor forest science**. *IDS Bulletin* **33**(1): 123-126. Two distinct visions of tropical forests co-exist in the scientific literature. One is more neo-Malthusian. The other is more pro-poor. The evidence increasingly favours the latter, although many uncertainties remain. The pro-poor literature emphasizes that poor families create and manage forests as well as destroy them, that the forests and the communities have evolved together, and that many forestry regulations and conservation initiatives hurt the poor without helping the forest. For those that support a more pro-poor vision, the challenge is to find ways to reach broader audiences with their message. That will require communicating in ways people can relate to and convincing them that they and the rural poor share many common interests.

Kaimowitz, D. 2003. **Forest law enforcement and rural livelihoods**. *International Forestry Review* **5**(3): 199-210. This paper discusses the problems faced by many forest dwellers and farmers caused through illegal logging activities and elaborates the legislative difficulties faced by these groups who are generally unrecognized as legitimate forest users and therefore powerless to defend themselves against unjust persecution. The widespread violation of existing forest laws and regulations was stated to have a major negative impact on forests, livelihoods, public revenues and the rule of law.

Kaimowitz, D. 2003. **From Rio to Johannesburg and beyond: forest conservation and rural livelihoods in the global South**. Quebec, Canada, The Organizing Committee of the XII World Forestry Congress. v. A - Forest for people. 10-16. URL: http://www.fao.org/DOCREP/ARTICLE/WFC/XII/C15-E.HTM. In the last few years, forests have lost their previous prominence on the international agenda. The forestry and conservation community needs to work hard to change that because forests can contribute greatly to meeting the challenges of poverty, disease, access to clean water, biodiversity conservation, climate change and violent conflict. There have been more successes than most policy-makers realize, particularly in the areas of devolving rights over forests to disadvantaged groups and forest restoration. Poverty Reduction Strategies should ensure that poor people maintain access to forest safety nets and provide support for small-scale forest-based enterprises. Biodiversity conservation strategies in developing countries should: 1) reduce incentives for forest destruction, 2) give rights to groups that are less likely to destroy forests; 3) pay people to conserve biodiversity, and 4) focus on landscape mosaics, in addition to supporting protected areas. World leaders should recognize the potential contribution of forests to global peace and take action to realize that potential.

Kaimowitz, D. 2004**. Useful myths and intractable truths: The politics of the links between forests and water in Central America**. In: Bonell, M. and Bruijnzeel, L.A. (Eds) *Forests, Water and People in the Humid Tropics, Past, Present, and Future Hydrological Research for Integrated Land and Water Management*. Cambridge University Press, Cambridge, UK, 86-98 pp. Public concern about watershed degradation is well intentioned and well founded. However, myths and misunderstandings underlie much of the discussion about how forest

cover relates to sedimentation, rainfall, and water flows. Deforestation probably has only a slight effect on large-scale flooding and regional rainfall. The policies that development and environmental agencies are currently pursuing to mitigate watershed degradation are unlikely to achieve that goal. Most projects emphasize soil conservation and tree planting, but pay scant attention to ensuring that farmers sustain those activities. Few projects select the locations for these efforts based on the potential off-site benefits and the areas involved are generally too small to have a significant impact at the landscape level. The emphasis on soil erosion resulting from agricultural activities diverts attention from other sources of erosion. Lack of clarity about whether the main objective is to provide off-farm benefits, increase agricultural productivity, produce forest products, or generate short-term employment often leads to efforts that do not effective achieve any of these goals. "This paper examines the policy debate related to the links between forests and water in Central America and the approaches policymakers and others have used to address the perceived problems, with emphasis on the siltation of large reservoirs. It shows how political, institutional, and technical factors have interacted to produce positive but sub-optimal results and offers suggestions for future initiatives. While the paper focuses on Central America, many of the arguments apply to other tropical regions. Section 2 provides a brief history of the debates surrounding watershed issues in Central America. Section 3 summarizes recent scientific literature on the biophysical and economic links between forests, climate, and water and sediment flows. Sections 4, 5, 6, and 7 look at the cases of the El Cajon hydroelectric dam in Honduras, the Lempa River watershed in El Salvador, the Panama Canal, and Hurricane Mitch, respectively. While these cases have many dimensions, this paper concentrates exclusively on the aspects related to off-farm hydrological effects. In addition, its main focus is specifically the role of *forest* cover. The articles notes: "…a good basic principle is that if the current land use provides the quantity and quality of water the population demands with an acceptable intra- and inter-annual distribution, any alteration will increase the risk of that situation changing. That is a strong argument for maintaining natural forest cover in many contexts. That being said, the evidence suggests that many of the claims about deforestation leading to reduced rainfall and dry season flows, greater flooding, and sediment flows that endanger dams and waterways in the medium term are exaggerated."

Kaimowitz, D. and Angelsen, A. 1998. ***Economic models of tropical deforestation: a review***. Center for International Forestry Research (CIFOR), Bogor, Indonesia, 139p. As international concern over tropical deforestation has grown over the last ten years, researchers have sought to understand the causes of deforestation and possible solutions using quantitative economic models. This book reviews the results and methodology of over 150 of these models and synthesizes the main lessons that can be learned from them. Higher agricultural prices, lower wages, less off-farm employment, and more roads generally lead to more deforestation. Major doubts remain on the impact of technological change, agricultural input prices, household incomes, and tenure security. The role of macro level factors such as population growth, poverty reduction, national income levels, economic growth and foreign debt is still largely uncertain. While the boom in deforestation modeling has yielded new insights, many model results should be regarded with caution because of poor data quality and methodological weaknesses. In particular, the book finds most multi country regression models to be of limited value. It recommends a shift in future research towards household and regional level studies, instead of the current emphasis on national and multi-country studies.

Kaimowitz, D. and Fauné, A. 2003.**Contras and comandantes: armed movements and forest conservation in Nicaragua's Bosawas Biosphere Reserve**. *Journal of Sustainable*

Forestry **16**(3/4): 21-47. In the 1980s, Nicaragua's Sandinista government faced armed mestizo and indigenous insurgencies in much of the nation's central and eastern regions. After the Sandinistas lost the 1990 elections, the in-coming government signed peace agreements with the insurgents and facilitated their return to civilian life. With the war over, the Nicaraguan army greatly reduced its troop strength, leaving tens of thousands of people unemployed. Within a few years, however, many former insurgents and soldiers took up arms again for multiple and complex reasons. This paper examines how three groups that rearmed influenced forest conservation in the buffer zone of Nicaragua's Bosawas Biosphere Reserve between 1991 and 1999. The three groups were the mestizo Northern Front 3-80 (FN 3-80) and the Andrés Castro United Forces (FUAC), made up of former 'Nicaraguan Resistance' and Sandinista soldiers respectively, and the Miskito YATAMA movement. The presence of these armed groups impeded the government from taking coercive action to remove farmers from the reserve's nucleus. It also limited the advance of cattle ranching. At times, the groups favoured logging, at times they did not. The armed conflicts have tended to keep out prudent foreign investors and encourage the presence of smaller companies willing to take greater risks.

Kaimowitz, D., Byron, N. and Sunderlin, W. 1998. **Public policies to reduce inappropriate tropical deforestation**. In: Lutz, E. (ed.) *Agriculture and the environment: perspectives on sustainable rural development*, World Bank, Washington, D.C., pp. 302-322. The ways and extent to which public policy measures might be used to reduce inappropriate tropical deforestation are investigated. The central thesis of the paper is that individuals and businesses deforest because it is their most profitable alternative. Policy options for reducing inappropriate deforestation are explored focusing on policies which: affect the prices of and demand for agricultural and forestry products; make production associated with deforestation more or less costly and risky; affect land speculation. Different ways of increasing the profitability of maintaining forests are explored and the issue of opportunity costs of capital and labour is addressed. The policies are evaluated according to six criteria: effectiveness, ability to be targeted, equity, political viability, direct cost, and indirect cost.

Kaimowitz, D., Erwidodo., Ndoye, O., Pacheco, P., Balanza, P.P. and Sunderlin, W.D. 1998. **Considering the impact of structural adjustment policies on forests in Bolivia, Cameroon and Indonesia**. *Unasylva* **49**(194): 57-64. A preliminary insight into how structural adjustment policies (SAPs) may have affected deforestation and forest degradation in the lowland tropical forests of Bolivia, Cameroon and Indonesia. It presents tentative hypotheses regarding how changes in prices, costs, incomes and government services associated with SAPs affect forests. The indirect effects of SAP's on forests resulting from changes in overall economic growth, inflation rates, employment and consumption are difficult to measure and predict. The experience of Cameroon and Indonesia indicate that SAPs that sucees in creating new off-farm employment opportunities probably reduce deforestation, while those that do not succeed have the opposite effect, but this is still inconclusive. There is little evidence that government spending restrictions associated with SAPs diminished governments' ability to promote sustainable forest management or control deforestation, largerly because there was minimal capacity in the first place. It remains to be seen whether SAPs will favour or hinder the development of such capacity in the future.

Kaimowitz, D., Pacheco, P., Mendoza, R. and Barahona, T. 2001. **Municipal governments and forest management in Bolivia and Nicaragua**. In: Palo, M., Uusivuori, J. and Mery, G. (eds.) *World forests, markets and policies*, Kluwer Academic Publishers, Dordrecht,

Netherlands, 279-288 pp. This paper analyses the growing role of municipal governments in Bolivia and Nicaragua in forest-related issues on the basis of some thirty case studies. It first provides background information on forest issues and legislation concerning municipal involvement in forest issues in the two countries. It then uses the case study material to derive some initial responses to six frequently asked questions about municipal forestry activities. It concludes that municipalities only devote a small proportion of their resources to these issues but show increasing interest and concern. Heavily forested municipalities tend to view forests as a productive asset, while the more deforested municipalities have greater concern for environmental degradation. Decentralization has opened opportunities for previously marginalized stakeholders to participate in forest policy decisions, but has not guaranteed that this will occur in every case. It has also favoured local producers over outside interests. Inter-agency environmental commissions have achieved mixed results in Nicaragua. Municipalities implement a variety of forestry activities. However, the impact of increased municipal participation in forest issues on both forests and local livelihoods remains small compared to the magnitude of the problems. National government agencies, donor projects, NGOs, and community organizations could substantially improve these impacts in the future.

Kaimowitz, D., Thiele, G. and Pacheco, P. 1999. **The Effects of Structural Adjustment on Deforestation and Forest Degradation in Lowland Bolivia**. *World Development* **27**(3): 505-520. Bolivia's structural adjustment policies, initiated in 1985, increased poverty among certain groups, but this did not lead to widespread migration to the agricultural frontier. Nor did adjustment greatly affect the average area planted in annual crops by small lowland farmers. Structural adjustment contributed to large-scale forest clearing for soybean production for export and, to a lesser extent, forest degradation by lumber companies. The economic benefits generated by soybean and timber expansion may have outweighed the environmental costs, but alternative policies might have reduced those costs and improved the distribution of the benefits.

Kaimowitz, D., Vallejos, C., Pacheco, P. B. and Lopez, R. 1998. **Municipal governments and forest management in lowland Bolivia**. *Journal of Environment & Development* **7**(1): 45-59. Recent decentralization and forestry laws in Bolivia give municipal governments a strong role in forest management. This article analyses the impact of those laws on local government activities related to logging, protected areas, indigenous territories, and land-use planning. It concludes that the laws have created new opportunities for indigenous people, small farmers, and small-scale timber producers to gain access to forest resources and influence forest policy, although they are not always able to take advantage of those opportunities. The article identifies both positive and negative trends with regard to the laws' impact on resource management, although it is premature to draw firm conclusions.

Kartawinata, K., Riswan, S., Gintings, A. N. and Puspitojati, T. 2001. **An overview of post-extraction secondary forests in Indonesia**. *Journal of Tropical Forest Science* **13**(4): 621-638. Indonesia has extensive areas of post-extraction secondary forests and degraded lands arising from intensive exploitation of forest resources in recent decades. Using the area of forests resulting from selective logging practices as an estimate, in year 2000, post-extraction secondary forests covered approximately 23 million ha, or approximately 55% of the total concession area. This paper analyses the underlying causes of transformation of primary to secondary forests and degraded lands, including policy and regulations in forestry and forest resources, poor enforcement of regulations, and the lack of recognition of timber exploitation rights for local communities. The government is committed to promoting participation of

local communities in managing forests. Recent policy changes for ameliorating some of the degrading factors have resulted in increased pressure on secondary forests due to rampant illegal logging and use claims by local communities and land speculators. While the largest proportion of post-extraction secondary forests has been maintained as part of the permanent forest estate, substantial areas have been converted for swidden agriculture, industrial tree and estate crop plantations and transmigration areas. Local community involvement and an understanding of the underlying degradation pressures would be imperative for the effective rehabilitation and sustainable management of post-extraction secondary forests.

Kelkar, G. and Nathan, D. 2001. **Gender relations in forest societies in Asia**. *Gender, Technology and Development* **5**(1): 1-32. Based on fieldwork several indigenous societies in South and Southeast Asia, this article explores the change in gender relations from a matrilineal and/or egalitarian system to one where male domination is present as the norm. Authors looked at changes in gender relations in forest societies in four situations: (a) colonial and state rule over forest communities and the takeover of forests; (b) historical and contemporary revolts of forest-dwelling women and men re-establish community control over forests; (c) the response of national states to these autonomy movements by shifting to devolution as a policy; and (d) the current situation, where women's inclusion in local forest management is becoming more a policy norm. However, these norms of women's inclusion, though still limited in space, have also come about through a process of struggle by women.

Kiker, C. F and Putz, F. E. 1997. **Ecological certification of forest products: Economic challenges**. *Ecological Economics* **20**(1): 37-51. With increasing rates of forest depletion worldwide, increasingly the question is being asked: Can markets play a role in mitigating the deleterious environmental and social impacts of forestry activities? The Forest Stewardship Council and others have proposed systems of 'ecological certification', where otherwise very similar products are viewed by consumers as different products because additional information on the products' history is provided. The 'certification' assures the consumer that the products have been produced with practices that meet fundamental ecological and social standards. For ecological certification systems to be viable and deliver products to the market over the long term, the relationships among key components must evolve economically and institutionally. Consisting of local forest management firms, local certifying non-government organizations, international non-government organizations, timber and product markets, the ecological certification system transcends local forests and communities to international markets. Conceptually, the system is a series of principal-agent relationships. This paper, in addition to developing the concept of ecological certification, analyzes the relationships among the many actors and the relationship of the actors to the forest.

Kobayashi, S. 2001. **Landscape rehabilitation of degraded tropical forest ecosystems: case study of CIFOR/Japan Project in Indonesia and Peru**. Seoul, South Korea, Seoul National University, College of Agriculture and Life Sciences. 11-23.

Kobayashi, S., Turnbull, J. W. and Cossalter, C. 2001. **Rehabilitation of degraded tropical forest ecosystems project**. In: Kobayashi, S., Turnbull, J. W., Toma, T., Mori, T. and Majid, N. M. N. A. (eds.) *Rehabilitation of degraded tropical forest ecosystems: Workshop Proceedings*, Bogor, Indonesia, 2-4 November 1999, Center for International Forestry Research (CIFOR), Indonesia, pp. 1-16. Tropical forests are being cleared at a rate of 16.9 million hectares per year and timber harvesting results in over 5 million hectares becoming secondary forests annually without adequate management. This decrease and degradation

affect both timber production and many environmental values. Selective and clear felling, and burning are major causes of land degradation. An assessment is needed of harvesting impacts that influence rehabilitation methods. The harvesting impacts on ecosystems vary with time and methods of logging, timber transporting methods, logged tree species, soil characteristics, topographies, local rainfall patterns, etc., and must be assessed in a range of conditions with long term monitoring. Increased supply of wood from plantation forests has the potential to reduce pressure on natural forest resources as well as contributing to environmental care and economic advancement for landholders. Short-rotation plantations can result in changes in nutrient storage and cycling processes due to factors such as harvesting wood, fertilizer application, erosion, leaching, and modified patterns of organic matter turnover. These factors can affect storage and supply of soil nutrients for tree growth and consequently the sustainability of plantation systems. Opportunities exist to manipulate soil organic matter through silvicultural practices but these must be technically feasible, economically viable and socially acceptable. The following research objectives are proposed: (1) evaluation of forest harvesting and fire impacts on the forest ecosystems, (2) development of methods to rehabilitate logged-over forests, secondary forests and degraded forest lands, (3) development of silvicultural techniques on plantation and degraded lands, and (4) network on the rehabilitation of degraded tropical forest ecosystems. It is anticipated that the results of these studies will contribute to the sustainable use of forest resources and environmental conservation.

Kobayashi, S., Turnbull, J.W., Toma, T., Mori, T. and Majid, N.M.N.A. (eds.) 2001. ***Rehabilitation of Degraded Tropical Forest Ecosystems: workshop proceedings***, 2-4 November 1999, Center for International Forestry Research (CIFOR), Bogor, Indonesia, 226p.

Kowero, G. Campbell, B. M. and Sumaila, U. R. (eds.) 2003. **Policies and governance structures in woodlands of Southern Africa**. Center for International Forestry Research (CIFOR), Indonesia.

Kumar, S. 2001. **Indigenous communities' knowledge of local ecological services**. *Economic and Political Weekly* **36**(30): 2859-2869. This paper investigates in detail the extensive indigenous knowledge of forest ecological services in 3 villages (Katwa, Karudih, and Hesadih) situated in the eastern plateau region of India. One aspect discussed is the indigenous knowledge on the influence of forests on water regimes and water quality. Differences in perceptions about the local ecological services and attendant practices within communities that are dependent on forests are then analysed under 2 contrasting land-tenure regimes, namely, community forests and state forests. It is argued that local ecological services are the missing link in designing plans for successful decentralization and sustainable management of forests.

Kvist, L.P., Andersen, M., Hesselsoe, M. and Vanclay, J.K. 1995. **Estimating use-values and relative importance of Amazonian flood plain trees and forests to local inhabitants**. *Commonwealth Forestry Review* **74**(4): 293-300. Use-values have been advocated as a tool to compare the value of not just individual species, but also of plant families and forest types to local people, e.g. to identify species or habitats in need of special management or conservation. Authors estimated use-values in three forest types (upper restinga, lower restinga, tahuampa) on the Amazon flood plain south of Iquitos (Peru), compared two methodologies, identified the most valuable species, and contrasted these valuations with the

actual use of forest resources in local villages. A new method for estimating use-values was contrasted with the method of Phillips and Gentry (1993a). Despite philosophical and procedural differences, estimates were highly correlated (r2=0.86). Limitations of both methods are discussed and some possible enhancements are suggested. The need to discriminate between past, present and potential uses is emphasized.

L.K. Snook, V.A. Santos Jimenez, M. Carreón Mundo, C. Chan Rivas, F. J. May Ek, P. Mas Kantún, A. Nolasco Morales, C. Hernández Hernández, C. Escobar Ruíz. 2003. **Managing natural forests for sustainable harvests of mahogany (*Swietenia macrophylla*): experiences in Mexico's community forests**. *Unasylva* **54**(214/215): 68-73. One hundred twenty-five communities in Quintana Roo, Mexico, control 800,000 ha of permanent production forests, from which they harvest timber, latex, building poles, thatch, and honey. Nearly 40 of these communities produce a total of 7,000 m^3/yr of mahogany timber. Over the past 20 years, their foresters have been developing management systems and silvicultural techniques to ensure sustainable harvests of this species, which was recently listed on CITES (the Convention on International Trade in Endangered Species) because it tends not to regenerate after logging. They asked researchers to support this process by establishing experiments and studies on their production forests. This article synthesizes the results of 7 years of research on mahogany regeneration, supported by CIFOR, which were presented to foresters, government agencies, and communities at a workshop in Mexico in November.

Lambin, E.F., Turner, B.L., Geist, H.J., Agbola, S.J., Angelsen, A., Bruce, J.W., Coomes, O.T., Dirzo, R., Fischer, G. and Folke, C. 2003. **The causes of land-use and land-cover change: moving beyond the myths**. *Global Environmental Change* **11**(4): 261-269. Common understanding of the causes of land-use and land-cover change is dominated by simplifications which, in turn, underlie many environment-development policies. This article tracks some of the major myths on driving forces of land-cover change and proposes alternative pathways of change that are better supported by case study evidence. Cases reviewed support the conclusion that neither population nor poverty alone constitute the sole and major underlying causes of land-cover change worldwide. Rather, peoples' responses to economic opportunities, as mediated by institutional factors, drive land-cover changes. Opportunities and constraints for new land uses are created by local as well as national markets and policies. Global forces become the main determinants of land-use change, as they amplify or attenuate local fact.

Larson, A. M. 2003. **Decentralisation and forest management in Latin America: towards a working model**. *Public Administration and Development* **23**(3): 211-226. The particular characteristics of natural resources make the decentralization of their management to elected local governments even more complex than the decentralization of services and infrastructure. Nevertheless, natural resources are equally important to rural development concerns in the Third World. Numerous countries have begun to implement policies for some form of decentralization involving natural resources and the environment, and many local governments are already making decisions that affect the future of local resources. This article reviews experiences with decentralization of forest management in Bolivia, Brazil, Costa Rica, Guatemala, Honduras and Nicaragua. Based on those experiences, it proposes a working model for more effective decentralization strategies. The model addresses the legal structure for decentralized forest management and relevant variables that define the local decision-making sphere, as well as key mediating factors that also affect outcomes. Most of these variables, even in the local sphere, offer important sites for policy and aid intervention.

Larson, A.M. 2002. **Natural resources and decentralization in Nicaragua: are local government up to the job?** *World Development* **30**(1): 17-31. Both decentralization and natural resource management literature suggest that natural resources could benefit from the redistribution of centralized management authority. Yet, neither has sufficiently examined the processes already underway in numerous developing countries to decentralize resource management from central to municipal government authorities. This study reviews the role of 21 local governments in forest management in Nicaragua. It finds that most interventions are economically motivated, and that three key factors are needed for local governments to be good resource managers: capacity, incentive and long-term commitment. These three factors are part of a process in which civil society can play a critical role.

Lopez, C. and Shanley, P. (eds). 2004. ***Riches of the forest: food, spices, crafts and resins of Asia***. Center for International Forestry Research (CIFOR), Bogor, Indonesia, 116p. This book contains 20 case studies that explain how a selection of forest resources featuring forest plans, animals and fungi are harvested, processed and traded. The botanical cases are presented according to the main part of the plant being used - the fruit, bark or resin. Sometimes the plants have multiple uses, or different cultures may use the same part of a particular plant in different ways. Animals and animal products that require forest habitat are also critical for rural livelihoods, and are represented in this volume by edible bird's nests and insect larvae. In each case, the book describes the main characteristics of the forest product, its historical usage, harvesting and management, and how it is processed and traded. In closing, each author comments briefly on trends and current issues regarding the resource. The final chapter reviews common themes and lessons that can be drawn from these cases.

Lopez, C. and Shanley, P. (eds). 2004. ***Riches of the forest: for health, life and spirit in Africa***. Center for International Forestry Research (CIFOR), Bogor, Indonesia, 115p. This volume brings to life 19 case studies featuring forest plants and animals. The botanical cases are presented according to the main part of the plant being used - the fruit, bark, roots or wood. Sometimes the plants have multiple uses, or different cultures may use the same part of a particular plant in different ways. Animals and animal products that require forest habitat are also critical for rural livelihoods, and are represented in this volume by bush meat and weevil larvae. In each case, the contributors describe the main characteristics of the forest product, its historical usage, harvesting and management, and how it is processed and traded. In closing, each author comments briefly on trends and current issues regarding the resource. The final chapter reviews common themes and lessons that can be drawn from these cases.

Mapaure, I. and Campbell, B.M. 2002. **Changes in Miombo woodland cover in and around Sengwa Wildlife Research area, Zimbabwe, in relation to elephants and fire**. *African Journal of Ecology* **40**: 212-219. One of the consequences of impacts of elephants and fire on woodlands is a change in woody cover, which often results in major challenges for wildlife managers. Changes in Miombo woodland cover in and around Sengwa Wildlife Research Area (SWRA) between 1958 and 1996 were quantified by analyzing aerial photographs. Woody cover in SWRA decreased from 95.2% in 1958 to 68.2% in 1996, with a lowest mean of 62.9% in 1983. The annual absolute rate of woody cover change in SWRA increased from -1.1% per-annum between 1993 and 1996, while the annual relative rate increased from -1.1% per annum between 1958 and 1964 to 3.3% per annum between 1993 and 1996. There was a strong negative correlation between elephant densities and woody cover in SWRA, suggesting that loss of woody cover was mainly due to elephants. Woodland recovery after 1983 was due to reductions in elephant populations through legal and illegal

off-take and reductions in fire frequency. Surrounding areas experienced less woody cover losses than SWRA, mainly due to tree removal by locals whose densities increased after the eradication of tsetse fly in the 1970s.

Masera, O.R., Garza-Caligaris, J.F., Kanninen, M., Karjalainen, T., Liski, J., Nabuurs, G.J., Pussinen, A., de Jong, B.H.J. and Mohren, G.M.J. 2003. **Modelling carbon sequestration in afforestation and forest magement projects: the CO2FIX V 2.0 approach**. *Ecological Modelling* **164**(1-2): 177-199. The paper describes the Version 2 of the CO2FIX (CO2FIX V.2) model, a user-friendly tool for dynamically estimating the carbon sequestration potential of forest management, agroforesty and afforestation projects. CO2FIX V.2 is a multi-cohort ecosystem-level model based on carbon accounting of forest stands, including forest biomass, soils and products. Carbon stored in living biomass is estimated with a forest cohort model that allows for competition, natural mortality, logging, and mortality due to logging damage. Soil carbon is modeled using five stock pools, three for litter and two for humus. The dynamics of carbon stored in wood products is simulated with a set of pools for short-, medium- and long-lived products, and includes processing efficiency, re-use of by-products, recycling, and disposal forms. The CO2FIX V.2 model estimates total carbon balance of alternative management regimes in both even and uneven-aged forests, and thus has a wide applicability for both temperate and tropical conditions. Results for the model testing and validation in selected temperate and tropical forest management systems are presented and discussed.

Mendoza, G. A. and Prabhu, R. 2000. **Multiple criteria decision making approaches to assessing forest sustainability using criteria and indicators: a case study**. *Forest Ecology and Management* **131**(1-3): 107-126. This paper describes the use of multiple criteria decision making techniques as decision tools for assessing criteria and indicators designed to evaluate sustainable forest management. Three techniques called ranking, rating, and pairwise comparisons are described and used within the framework of a generic set of criteria and indicators applied in a case study involving a forest concession in Kalimantan, Indonesia. For the case study, an assessment team consisting of national and international experts representing various disciplines was chosen to conduct an assessment of the forest concession. The criteria and indicators (C&I) developed by the Center for International Forestry Research was used as a reference. From this generic set of C&I, the assessment team made revisions to make the set more relevant to the prevailing conditions in the forest concession. This modified set was used in the assessment of the concession. Results from the study indicate that these techniques are effective tools both for selecting sets of criteria and indicators and eventually for prioritizing them. The methods are highly transparent, easy to understand, and offer a convenient environment for participatory decision making. These are desirable features of any evaluation process but most especially for a complex assessment problem such as forest sustainability

Mendoza, G. A. and Prabhu, R. 2003. **Qualitative multi-criteria approaches to assessing indicators of sustainable forest resource management**. *Forest Ecology and Management* **174**(1-3): 329-343. Criteria and indicators (C&I) have become primary tools in implementing the principle of sustainable resource management. To carry out this principle, it is necessary to develop methodologies that can holistically and systematically generate relevant indicators for a particular forest or resource management unit. This paper describes some methodologies that can be used as tools to carry out structured analysis of C&I. Multi-criteria analysis (MCA) is used as a decision-making tool to analyze and evaluate multiple C&I under a

participatory group decision-making environment. Use of the method enables the generation of C&I, estimation of their relative importance, estimation of the performance of each indicator relative to its desired condition, and assessment of the indicators' combined effect or impact. In addition to generating C&I and estimating their relative importance and performance, the paper also presents a soft methodology, called cognitive mapping, which can be used to assess the cross-indicator interaction, linkages, and connectivities of the indicators. The method attempts to evaluate the overall cumulative impacts of all indicators, individually and collectively, as they impact sustainability directly and indirectly through their interactions with other indicators.

Mendoza, G. A. and Prabhu, R. 2004. **Fuzzy methods for assessing criteria and indicators of sustainable forest management**. *Ecological Indicators* **3**(4): 227-236. This paper describes the general concepts, meaning, and definitions of sustainability and proposes the use of soft methodologies, particularly fuzzy set theory, for its assessment. Criteria and indicators (C&I) are described as instruments to assess forest sustainability. Basic elements and concepts of fuzzy sets are described, including membership functions and their interpretations in the context of sustainable forest management. Moreover, fuzzy operators that can combine the operational concepts of sustainability, namely criteria and indicators are described. A simple illustrative example is described to demonstrate the application of these methodologies.

Mendoza, G.A., Hartanto, H., Prabhu, R. and Villanueva, T. 2002. **Multicriteria and critical threshold value analyses in assessing sustainable forestry: model development and Application**. *Journal of Sustainable Forestry* **15**(2): 25-62. This paper presents different models designed to operationalise the principle of forest sustainability. Concepts such as resource or environmental utilization space, carrying capacity and critical thresholds are defined. The paper also describes an application of the qualitative and quantitative multicriteria models in assessing forest sustainability. Sustainability analysis was done in three stages: stage 1 involves the development of an appropriate set of criteria and indicators (C&I); stage 2 involves the use of multicriteria analysis (MCA) models for estimating relative importance of each C&I; and stage 3 involves the qualitative and quantitative assessment of each C&I. The qualitative model based on a simple flagging method where C&I elements are evaluated and assigned appropriate flag colors depending on the experts' judgements on their criticality. Similarly, the same set of C&I elements were also evaluated quantitatively using a scaled scoring system. These models were applied in a case study involving a community-managed forest in the Philippines. Feedback received from the assessors indicate that the models were found to be useful, transparent, and helpful tools in generating relevant sets of C&I and in evaluating these C&I with respect to overall forest sustainability.

Mendoza, G.A., Prabhu, R., Nyirenda, R., Standa-Gunda, W. and Mutimukuru, T. 2003. **A community-driven multi-criteria approach to developing indicators of sustainable resource management**. *Journal of Forest Policy* **10**(1): 1-21. Criteria and indicators (C&I) for sustainable resource management were generated under a facilitated community-driven approach where villagers took active roles, not only in the generation of the indicators but also in their subsequent assessment. The general procedure followed a two-stage process. Stage 1 involved a general 'scoping' process where C&I were generated by different groups and examined closely at plenary sessions. Stage 2 was aimed at assessing the indicators following a two-step process. Step 1 involved the evaluation of the indicators with respect to

their relative importance to the stated objectives or criteria. In the second step, the indicators were examined more closely. Inferences or judgements were made with respect to the indicators' current condition relative to their desired future condition or target value. Step 1 resulted in 'scores' of each indicator reflecting its condition relative to its target values. All of the processes and procedures were conducted under a participative and group decision making environment. The analyses were made using the general procedure of Multi-Criteria Analysis. The site used in the study was the Mafungautsi State Forest located in the Gokwe District of Zimbabwe. Thirty community participants coming from three sites were involved in the assessment.

Mertens, B., Forni, E. and Lambin, E F. 2001. **Prediction of the impact of logging activities on forest cover: a case-study in the east province of Cameroon**. *Journal Of Environmental Management* **62**(1): 21-36. The objective of this study was to test the value of the concept of the net commercial value of standing timber in predicting the impact of logging activities on forest-cover modifications. A study area was selected in the East province of Cameroon which contains major primary forests and which contributes strongly to national timber production. A Geographic Information System containing ecological and economic variables was used in combination with remote sensing data to define the net commercial value of standing timber in the East province. Taking account of the potential commercial value of standing timber improves our understanding of the spatial determinants of logging activities and of the resulting forest-cover modifications. The occurrence of logging-induced forest-cover modifications increases with the value of forest rent. In one of the study sites, half of the very high rent areas have already been logged. In that site, therefore, it is mostly the low rent or marginal forest areas that remain unlogged. This was not the case, however, throughout the study area as shown by the observations at another site.

Mertens, B., Poccard-Chapuis, R., Piketty, M.-G., Lacques, A.-E. and Venturieri, A. 2002. **Crossing spatial analyses and livestock economics to understand deforestation processes in the Brazilian Amazon: the case of São Félix do Xingú in South Pará**. *Agricultural Economics* **27**(3): 269-294. The Amazon is the largest tropical forest area on Earth, and has been undergoing rapid deforestation for the last four decades. In the Brazilian Amazon, large-scale pasture for cattle ranching and soybean production are the main land uses, leading to a yearly deforestation rate of 0.5%. These conversions are mostly located in frontier areas distributed along the so-called "arc of deforestation". Within this large zone, various land use change processes are interacting through several modes of land valuation and organisation. From several case studies in the State of Pará (Brazil), the current project aims at analysing how landscape dynamics are related to infrastructure development, ecological conditions, zoning policies and to the evolution and the organisation of the production, consumption and marketing chains of livestock products. This paper presents the results for one test site, the region of São Félix do Xingú, South of Pará. This region is the focus of land speculation, cattle expansion, and deforestation. Road construction, investments in electrical energy, financial credit for cattle, and the land reform policies have all fuelled this process. All these factors make this region one of the most dynamic agricultural frontiers in the Brazilian Amazon. The main objective of the paper is to improve our understanding of deforestation processes by crossing spatial analyses and livestock economics studies, and to characterise the role and impact of various natural and anthropic factors in the location and development of the main types of farmers, and their policy implications

Mertens, B., Sunderlin, W. D., Ndoye, O. and Lambin, E. F. 2000. **Impact of macroeconomic change on deforestation in South Cameroon: Integration of household survey and remotely-sensed Data**. *World Development* **28**(6): 983-999. The integration of information from household surveys and data on land-cover changes derived from remote sensing improves our understanding of the causes and processes of land-use/land-cover changes. A household survey covering 552 households in 33 villages was carried out in the East Province of Cameroon. This survey focused on land-use changes since the 1970s. Those data were related to time series of remote sensing satellite data. A major interest of the field data lies in the longitudinal framework of the survey. It highlighted the evolution of the household and its land-use over three periods related to the key macroeconomic periods, and corresponding to the dates of acquisition of the remote sensing data. The research results demonstrate that macroeconomic changes affecting Cameroon have played a fundamental role in the way land-use practices influence the forest cover. The results show that the annual rate of deforestation increased after the economic crisis as compared to the previous period. The household survey information enables identification of the causal relationships and the processes of land-use and land-cover changes. Observations reveal that the beginning of the economic crisis (1986) is associated in time with a strong increase of the deforestation rate related to population growth, increased marketing of food crops, modification of farming systems, and colonization of new agricultural areas in remote forest zones.

Moad, A. S. and Whitmore, J. L. 1994. **Tropical forest management in the Asia-Pacific region**. *Journal of Sustainable Forestry* **1**(4): 25-63.

Mullick, S.B. 2000. **Gender relations and witches among the indigenous communities of Jharkhand, India**. *Gender, Technology and Development* **4**(3): 333-358. Indigenous societies in India are showing an increasing tendency towards growing inequality in gender relations. This is more pronounced in societies that have integrated with mainstream Indian society. The objective of this paper is to determine id there is any co-relation between the growth of unequal gender relations and the widespread belief and practice of condemnation of women witches, particularly among the Munda and the Ho in Jharkhand in India. Through an analysis and interpretation of myths, legends and witch songs, the paper endeavours to see the belief in whichcraft in the context of the changing socio-economic condition of the indigenous peoples of India. The belief in witches and the targeting of women as witches are only the external manifestations of a deep-rooted gender struggle as patriarchy in the dominant Hindu society influences indigenous cultures.

Nasi, R., Meijaard, E., Applegate, G. and Moore, P. 2002. **Forest fire and biological diversity**. *Unasylva* **53**(209): 36-40. Forest fires have many implications for biological diversity. This article showed the effects of forest fires on the forest ecology, the impact of human-induced or severe natural wildfire on plant diversity, effects of fire on forest fauna and effects of suppression of the natural fire regime. In forest where fire is not a natural disturbance, it can have devastating impacts on forest vertebrates and invertebrates, loss of fruittrees results in overall decline in bird and animal species that rely on fruits for food. Deliberate human suppression of fire can also have direct negative impacts on species. However, not all species suffer from fire. Fire can have positive effects on wildlife populations in boreal forests, where fire is a major natural disturbance mechanism.

Nathan, D. and Kelkar, G. 2001. **Case for local forest management: environmental services, internationalisation of costs and markets**. *Economic and Political Weekly* **36**(30):

2835-2845. This paper looks at forests as sources of local environmental services (e.g. nutrient recycling and soil formation). It is through the fall in supply of these services that forest communities bear the external costs that are not included in the price of timber and other forest products. Local environmental services are taken into account in forest management decisions by local communities and form a basis for setting up local forest management systems. In arguing for the establishment of forest communities' property rights over forests, the paper supports the establishment of markets for regional and global environmental services provided by forests.

Negreros-Castillo, P., Snook, L. K and Mize, C. W. 2003. **Regenerating mahogany (Swietenia macrophylla) from seed in Quintana Roo, Mexico: the effects of sowing method and clearing treatment**. *Forest Ecology and Management* **183**(1-3): 351-362. Honduras or bigleaf mahogany (*Swietenia macrophylla* King) is the most commercially important timber species in the Neotropics, but it often does not regenerate successfully after harvesting. Effective methods are needed to sustain or increase mahogany yields by increasing regeneration. This study evaluates the effects of three treatments (slash, fell and burn; slash, fell and leave; and uprooting and pushing away trees using machines) used to open 0.5 ha clearings, plus a control under the forest canopy, and two sowing methods (surface-sown seed and buried seed) on the germination, establishment, survival, and early growth of mahogany. After 10 months, significantly more buried seeds yielded established seedlings (20%) than surface-sown seeds (9%), but there were no significant differences among clearing treatments. Establishment on controls averaged 18%. The percentage of seedlings that survived from 10 to 49 months varied significantly among treatments, from 53 to 54%, respectively, on the slash and burn and machine-cleared treatments to 16% on the fell and leave treatment and 26% on controls. Both slash and burn and machine-clearing reduced sprouting as compared to the fell and leave treatment, which had abundant sprouting from stumps of other species and the lowest establishment and survival of mahogany. Low survival on controls was probably due to low light levels. Forty-nine months after sowing, an average of 12% of the seeds buried in the slash and burn and machine-cleared treatments were represented by live seedlings, a rate substantially higher than on the fell and leave treatment (3%) and the control (6%). Yield from buried seeds averaged 9% as compared to 4% from surface-sown seeds. Seedling height at 49 months (average=66 cm) did not differ significantly among the clearing treatments or sowing methods, but on control plots average height of the few surviving seedlings was only 27 cm. The traditional slash and burn practice used for agricultural clearing seems to be a good way to prepare sites for seeding with mahogany and could be used as a silvicultural technique to facilitate regeneration. Consideration should be given to integrating these systems into forest management to help assure continued production of mahogany.

Nemarundwe, N. 2004. **Social charters and organisation for access to woodlands: institutional implications for devolving responsibilities for resource management to the local level in Chivi District, Zimbabwe**. *Society and Natural Resources* **17**: 279-291. The "paradigm shift" in natural resource management away from state-centred control toward community-based approaches in which local people play a much more active role is situated within the theoretical framework seeking to empower local communities through decentralization policies. This study examines the organizational framework within which decentralization is implemented using a case study from southern Zimbabwe. At the local level there is a complex interface between traditional and modern authority structures, with both complimentary and conflicting jurisdictions and mandates. Given this multiplicity of

organizations, the study advocates for systematic examination of appropriate organizations to be involved in the decentralization process.

Nhantumbo, I., Dent, J. B. and Kowero, G. 2001. **Goal programming: Application in the management of the miombo woodland in Mozambique**. *European Journal of Operational Research* **133**(2): 310-322. Community-based management of natural resources (CBNRM) is a priority in Mozambique's policy on forestry and wildlife resources. In essence the government's policy is to manage the natural resources in partnership with the rural communities and the private sector. This represents a change in policy in the agricultural and natural resources sectors, and has potential for significant impact in economic development. This paper demonstrates the potential for employing goal programming as a planning tool in participatory natural resource management in Mozambique. The focus is on the miombo woodlands, which are the main natural forest resources in the country and which most of the local communities, the forestry and tourist industries depend on for a variety of forest products and services.

Ojha, H., Pokharel, B., McDougall, C. and Paudel, K. 2003. **Learning to govern**: **how to improve monitoring system in community forestry in Nepal?**. *Journal of Forest and Livelihood* **2**(2): 23-34. Forest governance is now recognized as a critical factor for effective resource management and enhancing livelihood outcomes. This paper recognizes the need for having learning element in the governing process, for which there has to be a continuous monitoring process in place. Based on recent studies, the current monitoring system at different layers in Nepal's community forestry is reviewed, and opportunities for improved micro-macro linkages and forest governance are identified.

Oreshkin , D. G., Skovsgaard, J. P. and Vanclay, J. K. 1997. **Estimating sapling vitality for Scots pine (Pinus sylvestris L.) in Russian Karelia**. *Forest Ecology and Management* **97**(2): 147-153. A new method is proposed for estimating vitality or growth potential for saplings of Scots pine (*Pinus sylvestris* L.), based on height, diameter and height increment. A two-stage process was used to establish the vitality index. The logarithms of height, diameter and height increment were regressed against age, to adjust for the wide range of ages present in our data (c. 10,000 saplings with ages spanning 4–50 years). Then principal component analysis was used to obtain coefficients, which were, in turn, standardized on each axis to provide a vitality index scaled in standard deviations. This standardized scale allows the rank of an individual in the population to be assessed, and draws attention to possible outliers. The use of age-adjusted residuals ensured that the estimator was independent of age, and stable over a wide age range. The first principal component indicates if a sapling is relatively tall (weight = 0.5), thick (w = 0.5) or fast-growing (w = 0.7) for its age. Most of the information is contained in the first principal component, but the second component, which explains about 10% of the variance, appears to offer some utility as an indicator of `acceleration' due to changing conditions. The resulting measures of vitality have been useful for research and management in the dry lichen-moss pine forest in Russian Karelia, but are specific to this species, locality and ecotype. Further research and site-specific data are necessary to adapt the system to other situations.

Oyono, P.R. 2004. **The social and organisational roots of ecological uncertainties in Cameroon's forest management decentralisation model**. *European Journal of Development Research* **16**(1): 174-191. This paper examines Cameroon's model of forest-management decentralisation by characterising its organisational infrastructure and by

assessing – and anticipating – the ecological effects of those policy changes. The essay is based on nvironmental governance research conducted in Cameroon during the last three years. Five Community Forests, one Council Forest and nine forestry fee management committees were covered by the study. Methods of data collection included participant observation, analysis of historical trends, semi-structured interviews at the regional level, focus group meetings, historical transects of landscape and future scenarios. Qualitative data analysis aimed to understand forest-management organisations at the local level, modes of representation and accountability mechanisms. The first section describes the key reforms put in place by the new forestmanagement regime, including the institutional and socio-organisational choices legally prescribed for outlying actors in the decentralised management of forests and their revenues. The mechanisms connecting these institutional and socio-organisational choices to implementation – that is, the management of Community Forests, Council Forests and forestry revenues – are examined in the second part of the essay. The third section assesses the social outcomes of these processes. Ecological risks and uncertainties due to the way decentralised management is conducted at both the local and the regional levels are addressed in the fourth section. The Cameroonian decentralisation model, already registered some positive infra-outcomes. After all, decentralisation is not mechanical. It is not only explainable by laws and institutional arrangements: its implementation depends on many variables. It requires sufficient time to develop due to the complexity of human and institutional behaviour and because of unpredictability, variability, contingency and change, as well as many other stimuli. In sum, it is a 'story' o...(truncated).

Oyono, P.R., Mala, W.A. and Tonye, J. 2004. **Rigidity versus adaptation: contribution to the debate on agricultural viability and forest sustainability in southern Cameroon**. *Culture and Agriculture* **25**(2): 32-40. The Congo Basin is marked by the historical and cultural persistence, and resilience, of slash-and-burn agriculture – also known as shifting cultivation (or 'forest agriculture')-, on the one hand, and by contradictions between the relevance of externally introduced agricultural technologies and the implementation of productive agricultural mosaics, on the other. This paper examines these dynamics, insofar as they significantly influence the interface between forest and the 'cultivated space'. In the light of Southern Cameroon's case, and on the basis of theory, field observation, and discussions with the various actors, the paper explores the socio-cultural roots of slash-and-burn practices and draws up a typology of conceptual and scientific responses to the dilemma it represents for research, for land managers and for policy-making. Moreover, the paper shows that the articulation of agricultural cycles to agro-ecological units is evolving towards an integrated "agro-forestry" formula combining at the same time domestic fruit trees, food crops and non domesticated resources (forest trees and other forest products). These variables must be reconsidered in the design and the development of sustainable agro-ecological units based on a peaceful interaction and a progressive compromise between local communities' vision of agricultural mosaics and the scientific effort stimulated by the absolute introduction of alternative solutions to slash-and-burn agriculture.

Oyono, R.P. 2004. **One step forward, two steps back? Paradoxes of natural resources management decentralisation in Cameroon**. *Journal of Modern African Studies* **42**(1): 91-111.

Pacheco, P. 2004. **What lies behind decentralisation?: forest, powers and actors in lowland Bolivia**. *European Journal of Development Research* **16**(1): 90-109. This paper presents a case study of decentralized forest management in lowland Bolivia. Bolivia has

undertaken important policy reforms since the mid-1990s aimed at institutionalizing popular participation and promoting democratic decentralization. In the forestry sector, municipal governments have received important responsibilities, and various mechanisms have been established to hold these governments accountable to local populations. Nevertheless, in spite of being one of the most advanced forestry sector decentralizations in developing nations, the democratization of decision-making is still limited, with local governments being primarily responsible for monitoring forest management and illegal activities, and promoting forest management by local users. The national government has retained the right to define standards and allocate forest resources. Still, the political environment prompted by decentralization has created conditions for local forest users and municipal governments to become stronger players in natural resources governance. Given this complex context, outcomes of decentralization are mixed, mainly as a result of municipal resources and capacity, local power relationships and the degree to which local economies depend on forest resources.

Pambudhi, F., Belcher, B., Levang, P. and Dewi, S. 2004. **Rattan (*Calamus* spp.) gardens of Kalimantan: resilience and evolution in a managed non-timber forest product system**. In: Kusters, K. and Belcher, B. (eds.) *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Product Systems, Vol. 1. Asia*, Center for International forestry Research, Indonesia, 347-365 pp. Rattan cultivated as part of the traditional swidden agricultural system has been a major source of internationally traded rattan raw material and, more recently, the basis of a strong domestic furniture and handicrafts industry. The rattan gardens of Kalimantan provide an example of an intermediate non-timber forest product management system that is well adapted to the local economy and ecology. Over the past two decades, however, important changes have taken place, changes that tested the resilience of the system. Government policies designed to encourage the domestic processing industry and monopsonistic manufacturing association have sharply depressed demand and prices. New developments in the region, in the form of roads, industrial plantations, mining, and other new activities. Recent widespread forest fires have destroyed large areas of rattan garden, effectively forcing some rattan farmers out of business. Under current conditions, with low prevailing demand and prices, rattan gardens provide valuable ecological services, in term of biodiversity conservation and other forest functions. As rattan remains an important commodity in Indonesia and internationally, the rattan garden system may remain viable, at least in the medium term. Household survey in Besiq village suggests that it is an “active rattan village” of ~350 households with 334 households as commercial raw material producers. In Besiq more than 85% of the annual per capita cash income comes from rattan. On an average, monthly expenses in 28 active rattan villages with total 113 households is US$34.13 per household.

Parrotta, J. A., Turnbull, J. W. and Jones, N. 1997. **Catalyzing native forest regeneration on degraded tropical lands**. *Forest Ecology and Management* **99**(1-2): 1-7. Forest clearing, forest degradation through human disturbance, and the deterioration of land productivity due to inappropriate agricultural practices is a major problem in the tropics. Restoration of ecosystem health and productivity has generally relied on abandonment of land and subsequent natural forest succession. In recent years there has been consideration of management options to accelerate recovery and restore productivity, biodiversity and other values. The use of tree plantations to catalyze restoration of degraded forests and lands in the tropics was addressed at a symposium in Washington DC in June 1996. The conclusions and suggestions for future research to develop appropriate management options are reported.

There is strong evidence that plantations can facilitate forest succession in their understories through modification of both physical and biological site conditions. Changes in light, temperature and moisture at the soil surface enable germination and growth of seeds transported to the site by wildlife and other vectors from adjacent forest remnants. Development and design of management options to assist this process are required, taking into account socio-economic realities, development priorities and conservation goals.

Perera, G.A.D. 2001. **The secondary forest situation in Sri Lanka: a review**. *Journal of Tropical Forest Science* **13**(4): 768-785. Most forests in Sri Lanka are secondary, are mostly confined to the dry and intermediate zones of the country, and arise out of swidden agriculture. The majority of secondary forests which regenerate after swidden farming in the dry parts of Sri Lanka are grown from vegetative parts, that are from remaining roots and stumps. Secondary forests provide numerous products of importance to local people. They also help to bridge seasonal gaps in livelihoods. Secondary forests of Sri Lanka are being disturbed or transformed by intensive cultivation, fire, the implementation of development projects, the establishment of plantations and by the construction of houses by the local people. Secondary forests in the dry parts of Sri Lanka could be managed as conservation areas for timber production or for multiple uses. Regional climate, the ecology of secondary forests and anthropogenic pressures need to be considered when selecting suitable management options for a given site. Most of the secondary forests are heavily degraded and need to be rehabilitated. Intensification towards improved fallow systems or plantations is inhibited by poor site conditions, the threat of destruction by elephants, and insecure tenure.

Perez Cordero, L. D. and Kanninen, M. 2003. **Provisional equations for estimating total and merchantable volume of Tectona grandis trees in Costa Rica**. *Forests, Trees and Livelihoods* **13**: 345-359. The aim of this study was to develop equations which best predict individual-tree total volume and mercahntable volume for T. grandis in Costa Rica. A total of 112 trees with ages between 2 and 47 years and breast height diameter (dbh) between 2.4 and 58.7 cm were felled for stem analysis. Linear and non-linear regression analyses were used to model the relaitonship of total volume with dbh, with dbh and total height, and with age. The study also included merchantable volume equations that estimate merchantable volume to a minimum top diameter or bole length. The equations tested in this study fitted the observed data well. Other models, developed elsewhere, tended to overestimate the stem volume, especially at dbh bigger or the same 30cm. General geometric cylinder volume equations combined with a Stem Form Factor of 0.45 (widely used for T. grandis) were less precise than regression models when applied to this data set. Model validation with an independent data set suggested that the models should be calibrated with local data when grat accuracy is required (error less than 10%).

Perez Cordero, L. D., Kanninen, M., Ugalde Arias, L.A. 2003. **Stand growth scenarios for Bombacopsis quinata plantations in Costa Rica**. *Forest Ecology and Management* **174**(1-3): 345-352. In total 60 plots of approximately 80 trees each (including missing trees) were measured, with ages between 1 and 26 years. The main objective of this study was to develop intensive management scenarios for B. quinata plantations in Costa Rica to ensure high yielding of timber wood. The scenarios were based on a fitted curve for the relationship of DBH, and total height with age. A criterion of maximum basal area (18, 20, 22 and 24 m2 ha-1) was used to simulate different site qualities. Plantation density was modeled as a function of the crown area occupation of the standing trees. The scenarios consist of rotation periods between 23 and 30 years, final densities of 100–120 trees ha-1, mean DBH between 46 and

56 cm, and mean total heights of 30–35 m. The productivity at the end of the rotation varies between 9.6 and 11.3 m3 ha-1 per year, yielding a total volume at the end of the rotation of 220–340 m3 ha-1. The scenarios presented here may provide farmers and private companies with useful and realistic growth projections for B. quinata plantations in Costa Rica.

Perez Cordero, L.D. and Kanninen, M. 2003. **Heartwood, sapwood and bark content, and wood dry density of young and mature teak (Tectona grandis) trees grown in Costa Rica**. *Silva Fennica* **37**(1): 45-54. The aim of this study was to evaluate the heartwood, sapwood and bark content, and wood dry density of young and mature teak (Tectona grandis) trees. For this, 17 plantations were selected from 11 sites representing different climatic conditions and plantation densities (156 to 1600 trees ha-1, and line planting). From these plantations, a total of 87 trees with ages between 5 and 47 years were felled for stem analysis. The highest heartwood proportion of stem volume (over bark) was 61% and the lowest 0.4%. The sapwood proportion ranged between 24 and 72%, while bark represented from 14 to 37% of the total volume. Heartwood proportion was significantly different ($P<0.05$) among climatic zones: 'wet' sites producing less heartwood than 'dry' sites Stem diameter (under bark) and heartwood diameter at different stem heights differed among sample trees, even when plotted in relative values to avoid dependency with stem size. Dry density was statistically different between 8-year-old trees or younger and 47 year-old trees, and between line planting trees and 13-year-old trees or younger, but did not differ statistically between line planting trees and mature trees. No significant differences were found between climatic zones or between different stand densities. Dry densities values for T. grandis plantation in Costa Rica are similar to those reported elsewhere.

Perez Cordero, L.D.; Kanninen, M. 2003. **Aboveground biomass of Tectona grandis plantations in Costa Rica**. *Journal of Tropical Forest Science* **15**(1): 199-213. There are few studies on biomass distribution for Tectona grandis plantations in Costa Rica. This paper reports the distribution of total aboveground biomass of T. grandis and its relationship with diameter at breast height (dbh), age and stand density in plantations across Costa Rica. Foliage, branch, stem and total aboveground biomass were highly correlated both with dbh ($r > 0.91$) and with age ($r < 0.85$). Foliage dry biomass represented between 1 and 6% of the total tree dry biomass, while 5 to 30% corresponded to branches and 70 to 90% to stem dry weight. Per hectare aboveground biomass tended to incease with increasing age class (young, intermediate and mature). Foliage dry biomass varied between 3 and 9 Mg Ha-1, branch dry biomass between 11 abd 54 Mg Ha-1, stem dry biomass between 70 and 221 Mg ha-1, and total aboveground dry biomass between 84 and 284 Mg ha-1, and total aboveground dry biomass between 84 and 284 Mg ha-1. Significant relations between crown diameter and aboveground biomass with dbh, age and stand density, useful for the management of stand competition, are the main results of this study.

Pérez, M. R., Maogong, Z. Belcher, B., Chen, X., Maoyi, F. and Jinzhong, X. 1999. **The role of bamboo plantations in rural development: The case of Anji County, Zhejiang, China**. *World Development* **27**(1): 101-114. Bamboos have often been viewed as inferior products, labeled as the "poor man's timber." Development groups have proposed bamboo production as an opportunity for increasing the wealth of the lower-income groups. This paper is a study of the household economy of 200 bamboo farmers in eight townships of Anji County in China. The authors describe the process of transformation of rural China from communes to the household responsibility system, the differentiated rate of development among farmers and the role of bamboo in that change. A multiple regression analysis was carried out to study

the factors that influence farmers' incomes and their evolution. A warning is sounded against using bamboo production to target low-income groups, as well as relying solely on aggregated data when drawing conclusions on income disparities in China. The average annual farm household income for the period 1994-95 was 14,033 yuan, or 3,495 yuan per capita (1990 conversion rates were US$1=Yuan 4.80). This income was derived from four major sources: rice, livestock products (mainly pigs, chicken and ducks), bamboo and off-farm work (either as labor in the industry and construction sectors, or in business). Supplementary earnings came from other arable land (fruits and vegetables) and forest products (wood, timber and tea). bamboo is the second most important source of income after off-farm work, representing 25% of the total family income. The average annual household income from bamboo for 1994-95 was 3,551 yuan, or 886 yuan per capita. Bamboo culms contributed 84%, bamboo shoots accounted for 10% and the remaining 6% came from bamboo branches.

Persson, R. 2000. **Assistance to forestry: what have we learnt**? *International Forestry Review* **2**(3): 218-224. Assistance given to forestry, like ODA (Official Development Assistance) in general, presents problems. It is well known that commitment and ownership are needed in order to achieve success, but projects are still very much donor-driven. The best way to overcome current problems is to support Developing Countries' own strategies for development in general or in a selected sector. Such an approach is not very likely. Support to capacity building, research, learning, strengthening of analytical capacity and other 'basics' should then be favoured as a second 'best bet'. The main objective must be to strengthen domestic capacity within developing countries so that they can better appreciate the importance of forestry and take full charge of their own forestry development. Conditions imposed by donors or the pushing of donor agendas do not work in the long run.

Pinard, M. A., Putz, F. E., and Licona, J. C. 1999. **Tree mortality and vine proliferation following a wildfire in a subhumid tropical forest in eastern Bolivia**. *Forest Ecology and Management* **116**(1-3): 247-252. In 1994, 1×106 ha of subhumid forest in eastern Bolivia burned in an uncontrolled wildfire; the objective of this study was to measure tree and liana mortality a year after this fire. About 60% of 500 trees sampled were either killed or damaged by the fire. Proportionally more small trees (74% of trees >2 m tall but <5 cm dbh) were killed than large trees (27% of 10–40 cm, 16% of trees ≥40 cm dbh), and mortality varied with species. Basal cambial damage was found on 30–40% of living trees ≥10 cm dbh. About 75% of liana stems (1–8 cm dbh) were killed; 15% of the dead liana stems resprouted from the base. In lianas, basal resprouting of killed stems was independent of diameter class, whereas in trees smaller stems were more likely to resprout than larger stems. The proliferation of herbaceous vines plus lianas <1 cm dbh (mean density 21000 ha-1) in the burned forest may impede tree regeneration and supply fine fuels capable of supporting frequent fires. Although anthropogenic and natural fires have probably played important roles in the development of tropical subhumid forests, the amount of damage and mortality observed in this study suggest that, in forests managed for timber production, fire-protection practices are warranted to reduce forest susceptibility to wildfire.

Pinard, M. A., Putz, F. E., Rumíz, D., Guzmán, R. and Jardim, A. 1999. **Ecological characterization of tree species for guiding forest management decisions in seasonally dry forests in Lomerío, Bolivia**. *Forest Ecology and Management* **113**(2-3): 201-213. When the goal of natural forest management is to maintain the biodiversity and ecological integrity of the forest while harvesting timber, the silvicultural systems employed must promote timber

production and reduce negative impacts on non-timber resources. To foster development of such a system in a seasonally dry tropical forest in Lomerío, Bolivia, authors classified tree species according to their relative timber value, importance as food for vertebrate frugivores, and vulnerability to population declines when subjected to logging. Authors used this classification to identify a management system appropriate for the commercial species and to evaluate the compatibility of the system with the regeneration requirements of tree species that produce important food for mammalian wildlife. About half of the tree species in the site are commercially valuable for their timber and a similar proportion are considered of value as food for wildlife. A tree species rating for vulnerability to disturbance appeared to be independent of both timber and wildlife values. A silvicultural system that includes even-aged groups of trees within an uneven-aged matrix appears more suitable to the multiple goals of management in this forest than either an even-aged or uneven-aged (single tree selection) management system.

Pinard, M.A. and Putz, F.E. 1997. **Monitoring carbon sequestration benefits associated with a reduced-impact logging project in Malaysia**. *Mitigation and Adaptation Strategies for Global Change* **2**: 203-215. The Reduced-Impact Logging Project, a pilot carbon offset project, was initiated in 1992 when a power company provided funds to a timber concessionaire to implement timber harvesting guidelines in dipterocarp forest. The rationale for the offset is that when logging damage is reduced, more carbon is retained in living trees, and, because soil damage is minimized, forest productivity remains high. To estimate the carbon benefit associated with implementation of harvesting guidelines, a monitoring program was developed based on 1) field studies for measuring carbon stocks and flows; 2) a computer model of forest carbon dynamics for simulating various combinations of harvesting intensity and damage; and, 3) a projection model for calculating carbon balance over the project lifespan. Seventy-five percent of the carbon stored in this forest is in biomass, and of this, 59% is in large trees (>=60 cm diameter); consequently, reliable estimates of variables related to large trees are critical to the estimate of carbon benefits. Allometric methods for estimating belowground biomass are recommended over pit-sampling methods because of low cost-effectiveness of obtaining precise estimates of woody root biomass. Sensitivity analyses of variables used in the simulation model suggest that maintenance of ecosystem productivity has a large influence on long-term carbon storage in the forest. Projections of differences in carbon stores between the reduced-impact and conventional logging sites rely on assumptions about tree mortality, growth, and recruitment; published data for comparable sites in Malaysia are probably appropriate for estimating forest recovery from conventional but not reduced-impact logging. Continuing field work is expected to provide the data needed to evaluate assumptions of the models.

Pinard, M.A.; Putz, F.E. 1996. **Retaining forest biomass by reducing logging damage**. *Biotropica* **28**(3): 78-295.

Piotto, D., Montagnini, F., Ugalde, L. and Kanninen, M. 2003. **Growth and effects of thinning of mixed and pure plantations with native trees in humid tropical Costa Rica**. *Forest Ecology and Management* **177**(1-3): 427-439. Reforestation efforts are being promoted throughout the humid tropics in response to increased areas of deforested and abandoned or degraded lands. Farmers need technical information on species performance, plantation design and management in order to make appropriate choices of species and silvicultural techniques to achieve high productivity. In Costa Rica, government incentives have promoted the planting of native tree species, but information is still scarce on species

performance and silvicultural management. The present study examines the growth and responses to thinning of native species in mixed and pure-species plantations in the Caribbean Lowlands of Costa Rica. At 9–10 years of age, the species with best growth in diameter and volume were Vochysia guatemalensis Donn. Sm., Terminalia amazonia (J. Gmell) Excell, Jacaranda copaia (Aubl) D. Don, Virola koschnyi Warb. and Vochysia ferruginea Mart. Most species had better growth in mixed than in pure-species plantations. The slower growing species Calophyllum brasiliense Cambess and Genipa americana L. grew better in pure than in mixed stands. Mixed plantations (combinations of 3–4 species) ranked among the most productive in terms of volume. Trees responded to thinning with increased diameter growth, while height was not generally influenced by thinning. Tight initial spacing and thinning with high extraction of stems can improve growth and timber quality of stands. Results of the present research are useful to improve species choices for reforestation and plantation management in the humid lowlands of Costa Rica and in other regions with similar ecological characteristics.

Piotto, D., Montagnini, F., Ugalde, L. and Kanninen, M. 2003. **Performance of forest plantations in small and medium-sized farms in the Atlantic lowlands of Costa Rica**. *Forest Ecology and Management* **175**(1-3): 195-204. Exotic tree species predominate in reforestation in tropical regions worldwide. However, some native species are suitable for plantations, providing a wider variety of products. Adequate government programs of incentives, coupled with good technical advice to farmers, are needed to stimulate reforestation, especially among small and medium-sized farmers with limited financial resources. This project evaluates growth of native and exotic tree species on plantations in small and medium-sized farms in the Atlantic humid lowlands of Costa Rica, Central America. A total of 210 pure plantations, ranging in age from 6 to 11 years, were evaluated on 123 farms that had used government incentives for reforestation, and had received technical advice from local non-government organizations. For each species, seven plantations were chosen at random for study. In each plantation, plots of 15 trees each were chosen systematically for evaluation of diameter at breast height (dbh), total height, number of trees per hectare, tree form and spacing. Terminalia amazonia (J.F. Gmel) Exell, Hieronyma alchorneoides Allemao, and Vochysia guatemalensis Donn. Sm. were the most frequent species found in plantations in the region of study. Gmelina arborea Roxb. (exotic) and V. guatemalensis (native) had the highest mean annual diameter increment with 2.90 and 2.59 cm, respectively. Calophyllum brasiliense Cambess. (native) had the lowest mean annual diameter increment (1.48 cm). G. arborea and V. guatemalensis had the highest mean annual volume increment, followed by Tectona grandis (L.f) Lam. (exotic), and T. amazonia and Cordia alliodora (R&P) Cham. (both native). Although G. arborea had the greatest mean annual diameter increment, it had the lowest plantation density and problems with form. V. guatemalensis and T. amazonia, two native species, were the most promising species for reforestation, due to good growth in volume, good form, and adaptability to a variety of sites.

Piotto, D., Víquez, E., Montagnini, F. and Kanninen, M. 2004. **Pure and mixed forest plantations with native species of the dry tropics of Costa Rica: a comparison of growth and productivity**. *Forest Ecology and Management* **190**(2-3) 359-372. In Costa Rica, most reforestation trials with native species were established in the tropical humid regions. In the dry tropics, research on the performance of native species in forest plantations is incipient and trials comparing pure and mixed designs are limited. This paper presents the results of two experimental plantations with native trees in pure and mixed plots in the dry tropics of Costa Rica. The growth and productivity of 13 native species in pure and mixed plantations

was compared with *Tectona grandis* (L.f.) Lam., an exotic species broadly used in the region. In a plantation of relatively slower growing species, measurements taken at 68 months of age resulted in *Samanea saman* (Jacq.) Merril. and *Dalbergia retusa* Hemsl. demonstrating the best growth, followed by *Astronium graveolens* Jacq. and *Swietenia macrophylla* King. Measurements in a plantation of relatively faster growing species, at 68 months of age, showed that growth of *Schizolobium parahyba* (Vell.) Blake was greatest in the pure and mixed plots, followed by *Terminalia oblonga* (Ruiz & Pav.) Steud., *Anarcadium excelsum* (Bert. & Balb. ex Kunth) Skeels and *Pseudosamanea guachapele* (Kunth) Harms. The native species grew better in the mixed plots. The pure plots of *T. grandis* (L.f.) Lam. were the most productive, compared to all species and the mixture of species. Plantations of *T. grandis* (L.f.) Lam. seem to be well adapted to the region and are certainly a commercially interesting alternative. Nevertheless, mixed plantations with native species would contribute more to sustainable management, because while single-species plantations do not provide a great range of goods and services when compared to the natural forest, mixed plantations are likely to increase this range of benefits

Pokorny B., and Schanz, H. 2003. **Empirical determination of political cultures as a basis for effective coordination of forest management systems**. *Society and Natural Resources* **16**(10): 887-908. To design viable strategies to implement sustainable forest management, tools are needed that allow the understanding and management of the driving forces behind conflicting opinions and divergent solutions. The approach of Thompson et al. (1990) to cultural theory - because of its descriptive power - may be an ideal basis to create such tools. The possibility of determining empirically the cultural bias of the actors and groups involved is fundamental to this approach. Authors conducted a pilot study in the eastern Amazon region to explore the possibility of characterizing individuals according to the four types of political culture defined by Thompson et al. The findings indicated that the empirical classification of individuals is possible but complex. A relation between the types of political cultures and perceptions of sustainable forest management was observed. A systematic elaboration of adequate indicators and assessment methods is crucial in exploring the potential of transferring the theoretical approach into practice.

Pokorny, B. and Adams, M. 2003. **What do criteria and indicators assess? An analysis of five C&I sets relevant for forest management in the Brazilian Amazon**. *International Forestry Review* **5**(1): 20-28. The diversity of criteria and indicators (C&I) sets is often a cause for uncertainty and confusion, and probably one of the reasons for the still unsatisfactory acceptance of C&I as a support for implementation of sustainable forest management. In order to address this erosion of confidence in C&I this paper evaluates the diversity of five C&I sets (CIFOR, ACM, FSC, ITTO and Tarapoto) relevant for the Brazilian Amazon by analysing frequencies of C&I in relation to parameters about content and quality. The study demonstrated that the C&I sets, although addressing the social, technical, ecological and economic dimensions of sustainability, exhibit different thematic foci. A general lack of validity was attested as well as missing specificity and practicability of the indicators. In order to increase objectivity and transparency, the C&I have to reflect more clearly and unambiguously what is actually assessed. It is recommended to include a discussion about verifiers and assessment methods in the development of C&I sets. To avoid misunderstandings and to introduce the possibility for less complex and more practicable C&I sets, the authors recommend constriction of the objective of the assessment to more clearly serve the potential clients and frame-conditions for its application.

Pokorny, B., Cayres, G. and Nunes, W. 2003. **Participatory analysis of heterogeneity, an approach to consolidate collaborative initiatives at community level**. *Forests, Trees and Livelihoods* **13**(2): 161-175. Insufficient attention had been given to the development of effective and practicable methodologies to actively involve intra-community groups in constructive discussions about their own heterogeneity and its implications for collaborative action. An approach to participatory analysis of group heterogeneity was tested in three communities in the Eastern Amazon (Pará, Brazil), using four steps: (1) identification of criteria for heterogeneity; (2) definition and characterization of stakeholder types within the community; (3) identification of difficulties, contributions and expectations related to each type; and (4) discussion of findings. The study revealed that the participants of collaboratively working groups at community level are very diverse in their individual characteristics, interests and values. By defining criteria of heterogeneity, developing a typology and using a symbolic language, the groups were enabled to define issues critical to their group and ensure their interest, understanding and acceptance of the aspects discussed. The smallest unit in the typology was in all cases a group member and their related family. Emotional parameters played a key role in people's perceptions of heterogeneity. The proposed approach can be adapted in many ways to facilitate learning about heterogeneity, motivation and the interests of local stakeholders.

Pokorny, B., Prabhu, R., McDougall, C. and Bauch, R. 2004. **Local stakeholders' participation in developing criteria and Indicators for sustainable forest management**. *Journal of Forestry* **102**(1): 35-40. Criteria and indicators (C&I) for sustainable forest management are important tools to improve the quality of forest management. In most cases they have been developed by experts, but the participation of stakeholders is essential if the C&I are to be locally relevant and practicable. Authors asked four stakeholder groups to apply a set of C&I to a forest management unit in the eastern Amazon basin. The study confirmed the importance of involving stakeholders and demonstrated that effective efforts begin with well-defined and clearly understandable C&I. Stakeholders were better able to apply and adapt measurable verifiers than the more indicators and criteria. Intensive communication about personal experiences and subjective interpretations is necessary to prevent misunderstandings and misinterpretations. Our study also confirmed the general practical applicability of C&I and revealed their potential as instruments of communication and learning.

Pound, B., Snapp, S., McDougall, C. and Braun, A. (eds.). 2003. ***Managing natural resources for sustainable livelihoods: uniting science and participation***. London, UK, Earthscan Publications, 352p. Drawing on extensive and varied case studies, this book presents innovative approaches for establishing and sustaining participation and collective decision-making in natural resource management research. It covers a wide range of natural resources – including forests and soils, water and management units such as watersheds and common property areas – and provides practical lessons from analysis and meta-analysis of cases from Asia, Africa and Latin America. It offers insights on how to make research participatory while maintaining rigour and high-quality science at various scales.

Purnomo, H., Mendoza, G.A. and Prabhu, R. 2004. **Model for collaborative planning of community-managed resources based on qualitative soft systems approach**. *Journal of Tropical Forest Science* **16**(1): 106-131. A qualitative soft system model is proposed in this paper to address the inherent complecity of community-based resource management. The model follows the principles of participatory management where local stakeholders are fully

engaged in different phases and stages of planning and decision making. The process starts with an open exploration of views and perspectives from all participants. Collaborative or participative modelling follows where the multiple views, perspectives and concerns are systematically organized and structured into a qualitative model describing the interrelationships, interactions, and causality relationships of the diverent management compponents, particularly the relevant indicators. The modeling process allows direct participation an involvement of all stakeholders. Hence, the resultant model is a product of the collective knowledge, expertice, and experince of the stakeholders. The model and the modelling process offer an excellent environment for learning on the part of the stakeholders as they formulate the relevant components, indicators and thir dynamic interactions. The proposed approach is demonstrated using a case study involving forest communities within the Pasir District located at Kalimantan, Indonesia.

Putz, F. E. 2000. **Economics of home grown forestry**. *Ecological Economics* **32**(1): 9-14. Costs of applying silvicultural treatments prescribed to increase yields of timber and non-timber forest products from natural forests should be calculated differently for industrial logging companies, private non-industrial forest owners, and community based forest management operations. For forest owners who are not concerned solely with maximizing short term profits from their forests, the opportunity costs of forest labour are often lower than official minimum wages. Furthermore, for forest owners who do not have ready access to interest-accruing savings mechanisms or where bank solvency is in question, the opportunity costs of waiting for long rotation forest crops to mature may not be as high as public interest rates would suggest. Both the true costs of management and the multitude of marketed and non marketed benefits from well managed natural forests need to be considered when assessing forestry as one component of a diverse portfolio of conservation options.

Putz, F. E. 2000. **Some roles for North American ecologists in land-use planning in the tropics**. *Ecological Applications* **10**(3): 676-679. Land use planning is a multi-dimensional undertaking that should be based on sound ecological principles but also needs to be acceptable on social and economic grounds and should reflect institutional and political constraints and opportunities. For ecologists, the challenges associated with contributing to the ecological sustainability of community-based forest management and other land use decisions are numerous. Ecologists from the United States have the potential to contribute a great deal towards improved land use decision making in Developing Countries. Ecologists can help in Less Developing Countries by advocating complete ecosystem protection wherever feasible while providing scientific input along the sustainable-use pathway to conservation.

Putz, F. E. 2004. **Multiple quests for the best criteria and indicators of sustainable tropical forest management: Worthwhile endeavors or a smokescreen?** *Ecology and Society* **9**(1): r1. [online] URL: http://www.ecologyandsociety.org/vol9/iss1/resp1Author contends that loggers use the lack of consensus about the criteria and indicators (C&Is) of sustainable forestry to justify not employing any of the already available sustainable management techniques. By repeatedly attempting to redefine good forest management when the functional, performance-based C&Is of the Forest Stewardship Council (FSC) are being implemented and improved upon all over the world, those who perpetuate the C&I debate contribute to confusion that permits destructive logging to continue or accelerate. Author does not question the motives of scientists trying to define good forestry. However, some supporters of C&I definition projects seem to be intentionally promoting uncertainty. Their

projects have been little more than academic exercises that divert resources away from sustainable forest management efforts encouraged by the FSC. Author also notes that the FSC is not perfect. It was designed to allow for improvement, and it is open for input from stakeholders. Quests to improve C&Is for tropical forest management should be applauded if they help forest management practices become more socially acceptable, economically viable, and environmentally sound. Nevertheless, researchers should beware that if they insist on trying to establish new certification programs, they may be helping unscrupulous groups get rich by exploiting the business-as-usual approach to forest management in the tropics [excerpts].

Putz, F.E. and Viana, V. 1996. **Biological challenges for certification of tropical timber**. *Biotropica* **28**(3): 323-330.

Putz, Francis E., Blate, Geoffrey M., Redford, Kent H., Fimbel, Robert & Robinson, John 2001.**Tropical forest management and conservation of biodiversity: an overview**. *Conservation Biology* **15** (1): 7-20.

Putz, Francis E., Dykstra, Dennis P. & Heinrich, Rudolf. 2000. **Why poor logging practices persist in the tropics**. *Conservation Biology* **14** (4): 951-956. Despite abundant evidence that both the environmental damage and the financial costs of logging can be reduced substantially by training workers, pre-planning skid trails, practicing directional felling, and carrying out a variety of other well-known forestry practices, destructive logging is still common in the tropics. Based on our collective experience with loggers in tropical forests, authors discuss seven possible reasons for this seemingly irrational behavior. The principal reason poor logging practices persist is apparently that the widely heralded cost savings associated with reduced-impact logging relative to unplanned logging by untrained crews may not be realized under some conditions. In particular, where compliance with logging guidelines restricts access to steep slopes or prohibits ground-based timber yarding on wet ground, reduced-impact logging may be synonymous with reduced-income logging. Given that under such conditions loggers may not adopt reduced-impact logging methods out of self-interest, fiscal mechanisms for promoting sustainable forest management may be needed.

Ramakrishnan, P.S. and Kushwaha, S.P.S. 2001. **Secondary forests of the Himalaya with emphasis on the north-eastern hill region of India**. *Journal of Tropical Forest Science* **13**(4): 727-747. Secondary forests form a major component of the forest types in the Central Himalayan region and in the north eastern hills of India. Deforestation in these areas is largely due to external pressures of timber extraction for industrial use. When large scale deforestation from outside the region is superimposed upon the demands of the local communities for food, fodder and fuelwood, the previously balanced use of forest resources, including the management of swidden fallow secondary forests, becomes impaired. Understanding the local linkages between ecological and social processes is important in order to design strategies for the sustainable management of secondary forests in the region where traditional societies live. A particular approach suggested is to benefit from the sociocultural heritage related to keystone species such as *Alnus nepalensis*. The traditions around these and related species and their particular ecological attributes allow for the design of adaptive management strategies to resolve problems with both environmental and sociocultural dimensions. In designing such an adaptive management plan that could be operationalised at the landscape level where both natural and human managed agro

ecosystems are well integrated, designing appropriate institutions at the local level is important for ensuring community participation.

Resosudarmo, I.A.P. 2004. **Closer to people and trees: will decentralisation work for the people and the forests of Indonesia?**. *European Journal of Development Research* **16**(1): 110-132. For over 30 years, Indonesia's central government controlled its forests, the third largest area of tropical forests in the world. Driven by serious political, administrative, and economic demands for reforms, the central government has begun to decentralize, transferring new powers to the district and municipal levels. Decentralization in the forestry sector has included transferring income from permits, logging and reforestation fees, as well as the right for these lower levels of government to issue logging permits. This sudden, new access to Indonesia's lucrative timber market has led local peoples and governments to rush to take advantage of a resource to which they previously had little right. The result has included the proliferation of permits with little regard for the effect on forest resources. Large areas, including some protected areas, are being destroyed and threatened with conversion to other uses. Local peoples, however, appear not to have been the ones receiving the primary benefits; they have been taken instead by those who have the required capital for permits and logging.

Ruiz Perez, M. and Byron, R.N. 1999. **A methodology to analyse divergent case studies of non-timber forest products and their development potential**. *Forest Science* **45**(1): 1-14. Debate currently rages over the development potential of Non-Timber Forest Products (NTFP) in tropical forests. Proponents of particular "solutions" can refer to evidence (case studies, data) which tend to support their interpretation of events and relationships. Recommendations thus frequently depend on how data are classified and interpreted. Inaccurate or incomplete classification leads to defective subsequent theories, models, and recommendations. Authors present a method for classifying very divergent case-study data, and some initial results as a basis for general understanding of key factors that influence a given result. Crucial issues determining outcomes of NTFP development include the nature of government involvement, distribution of property rights, the ability of local people to claim and enforce such rights, market transparency, and pressure on the resource. This paper concludes with suggestions for further testing and development of the methodology.

Ruiz Perez, M., Fu Maoyi, Yang Xiaosheng, Belcher, B. 2001. **Bamboo forestry in China: toward environmentally friendly expansion**. *Journal of Forestry* **99**(7): 14-20. Bamboo, with a long tradition in China, is one of the emerging sectors in the Chinese economy. It is making an increasingly large contribution to farmers' income and playing an important role in rural industrial development. Bamboo products are also being substituted for wood products, a process that has been accelerated by a variety of policy measures. However, the bamboo expansion has come at a cost to the environment. This article discusses the bamboo sector, with particular focus on Anji County (Zhejiang), and reviews the new policies being applied in an attempt to integrate the interests of development and the environment.

Salafsky, N. and Wollenberg, E. 2000. **Linking livelihoods and conservation: A conceptual framework and scale for assessing the integration of human needs and biodiversity**. *World Development* **28**(8): 1421-1438. Although there has been increasing interest in trying to link the livelihoods of people living near natural resources to the conservation of those resources, there has been little attempt to systematically assess or measure this linkage. Authors develop a conceptual framework for defining the linkage between livelihood

activities and conservation. Authors then develop a scale to assess the strength of linkage across five dimensions: species, habitat, spatial, temporal and conservation association. The framework is then tested and scaled by evaluating 39 project sites in the Biodiversity Conservation Network. Finally, authors discuss the relevance of linkage to designing appropriate conservation strategies.

Salim, A., Brocklesby, M. A., Tiani, A. M., Tchikangwa, B., Sardjono, M. A., Porro, R., Woelfel, J. and Colfer, C. J. P. 2001. **In search of a conservation ethic**. In: Colfer, C. J. P. and Byron, Y. (eds.) *People managing forests: the links between human well-being and sustainability*, Resources for the Future, Washington, USA, pp. 155-170. The study uses the Galileo multidimensional scaling method to define and measure a conservation ethic at several sites in Indonesia, Cameroon and Brazil. Several hypotheses were developed: (i) the concept of forest would be considered closer to spirit concepts in forest-rich areas than in forest-poor areas; (ii) forest-rich sites would be characterized by perceptions of forest that were closer to good and future than forest-poor sites; and (iii) people would be closer to forest in forest-rich sites than in forest-poor sites. Analyses showed that the Galileo method was not effective in measuring a conservation ethic.

Satyawadhana, C. 2001. **Appropriation of women's indigenous knowledge: the case of matrilineal Lua in northern Thailand**. *Gender, Technology and Development* **5**(1): 91-112. The Lua, according to their mythology, are the original inhabitants of Thailand. Today, however, hey are regarded as ethnic minorities who inhabit this region. A study of their myths and legends reveals the importance of spirit cults, matriclans, and women's role in the discovery, production, and trade of salt. The matriclan system is also established in the longhouses and their ocial structure. However, with the entry of the Thai state, power has shifed from the Lua women to Thai men who represent the state. This has also resulted in the appropriation of women's traditional knowledge about the technology and rituals surrounding forest conservation and sustainable use of resources. Further, there has been a shift in gender relations in favor of men among the Lua people.

Sayer, J. A. and B. Campbell. 2001. **Research to integrate productivity enhancement, environmental protection, and human development**. *Conservation Ecology* **5**(2): 32. [online] URL: http://www.consecol.org/vol5/iss2/art32 To meet the challenges of poverty and environmental sustainability, a different kind of research will be needed. This research will need to embrace the complexity of these systems by redirecting the objectives of research toward enhancing adaptive capacity, by incorporating more participatory approaches, by embracing key principles such as multi-scale analysis and intervention, and by the use of a variety of tools (e.g., systems analysis, information management tools, and impact assessment tools). Integration will be the key concept in the new approach; integration across scales, components, stakeholders, and disciplines. Integrated approaches, as described in this Special Feature, will require changes in the culture and organization of research.

Sayer, J. A. and Byron, R. N. 1996. **Technological advance and the conservation of resources**. *International Journal of Sustainable Development and World Ecology* **3**: 43-53.

Sayer, J. A., Vanclay, J. K. and Byron, N. 1997. **Technologies for sustainable forest management: challenges for the 21st century**. *Commonwealth Forestry Review* **76**(3): 162-170. Technology will help to address the challenges for sustainable forestry in the 21st century. Some of the challenges will include the shift of production from native forest to

plantations in areas of comparative advantage, more efficient processing delinking end-use products from raw wood characteristics, increased demand, better information technologies to support decision makers, and more options for conserving biodiversity. Definitions of sustainability will vary in time and space as society's expectations and aspirations change, so there can be no 'silver bullet' to ensure sustainability. However, progress may be facilitated with a systematic approach to forest management embracing the usual planning cycle: formulation of objectives, preparation of a strategy, planning, implementing, monitoring, and reappraisal. This requires a good understanding of each particular situation. Managers need good resource assessment and decision support systems; they must foster stakeholder participation in decisions, costs and benefits; and ensure effective procedures to resolve conflicts. Within an appropriate system, technical advances such as better machines and new implements may help to make a difference, but will not in themselves ensure sustainability. The important technologies for sustainable forestry are those that foster better communication between stakeholders and allow informed decisions spanning scales from the gene to the ecosystem. This remains an important challenge for forest managers in their search for sustainability.

Sayer, J., Chokkalingam, U. and Poulsen, J. 2001. **The restoration of forest biodiversity and ecological values**. In: *Restoration research of degraded forest ecosystem. Proceedings of International Seminar*, Seoul, Korea, 13-14 April, 2001, Seoul National University, College of Agriculture and Life Sciences, Suwon, Korea Republic, 1-12 pp. Many schemes implemented in the name of ecological restoration for degraded forests have failed to yield the benefits expected of them. We need ecosystem approaches to restoration, need to view forest fragments as biodiversity refuges; restoration must attempt to favour indigenous biodiversity, and design suitable incentives for restoration.

Sayer, J.A. and Campbell, B.M. 2004. ***The science of sustainable development: local livelihoods and the global environment***. Cambridge, UK, Cambridge University Press. xix, 268p. This book attempts to redefine roles of government agencies, development assistance programmes and science in achieving a more sustainable future of rural landscapes in tropical developing countries. Science faces major challenges in tackling the inter-linked problems of poverty and environmental sustainability. This book reviews how practical science can be applied to real-life conservation and development problems, and aims to demystify the sometimes obscure science of natural resources management, interpreting it for the benefit of those who need to deal with the day-to-day problems of managing complex natural resource systems. The book responds to needs expressed by the Convention on Biological Diversity, the Global Environment Facility and many other international fora where the problems of conserving the environment in poor countries are debated. It gives practical guidance to those who design and manage conservation programmes and demonstrates that new technologies are now available that enable integrated natural resource management to move from a theory to a reality. The threats to the natural environment posed by globalisation require an integrated response that can yield real benefits to those living in tropical developing countries, whilst also achieving global environment objectives. Contents of the book are: Preface; Acknowledgements; Part I. Rising to the Challenge of Complexity: 1. The challenge: alleviating poverty and conserving the environment; 2. Dealing with complexity; 3. Getting into the system - multiple realities, social learning and adaptive management; 4. issues of scale; 5. Confronting complexity - models, knowledge and negotiation; Part II. Realities on the Ground: 6. Institutions for managing natural resources in African savannahs; 7. Forest margins in Indonesian Borneo; 8. Learning by doing on tropical American hillsides; Part III.

Achieving Successful Research-Based Management: 9. The spread of innovations; 10. Measuring success; 11. Achieving research-based management; Index.

Sayer, J.A., Ishwaran, N., Thorsell, J. and Sigaty, T. 2000. **Tropical forest biodiversity and the world heritage convention**. *Ambio* **29**(6): 302-309. The World Heritage Convention has been ratified by 158 countries and provides an international legal regime for the conservation of sites of global, cultural or natural value. There are 33 tropical forest sites listed under the convention, mainly for their global biodiversity value. They constitute an elite set of biodiversity sites covering approximately 2.5% of the world's closed tropical forests and making a significant contribution to the conservation of the world's terrestrial biodiversity. A range of international initiatives will eventually provide a framework for better conservation and sustainable management of forests worldwide, but the World Heritage Convention provides an existing mechanism, which could quickly be mobilised to safeguard the most important forests. In the past, sites were selected for listing under the convention if they were perceived to have minimal human impact. However, all forests are modified by humans but that modification need not be inconsistent with the maintenance of global biodiversity values. The Convention could have greater impact if it addressed more directly the reality of the ubiquitous human modification of forests. This could be achieved through use of more adaptive forms of management based on objective criteria and indicators to define tolerance of change and trigger management responses to achieve desired biodiversity outcomes. It is concluded that an optimal list of world heritage tropical forest sites might include up to 100 sites or clusters of sites and that such a network of sites could effectively protect a high proportion of the world's forest biodiversity. The present rate of attrition of the world's tropical forests suggests the need for urgent international action to focus on a set of priority sites and the World Heritage Conservation could provide the best international framework for such action.

Sayer, J.A., Zuidema, P.A. and Rijks, M.H. 1995. **Managing for biodiversity in humid tropical forests**. *Commonwealth Forestry Review* **74**(4): 282-287. One of the major issues surrounding the debate on sustainability of management of tropical forests is the impact of different forest management strategies on biodiversity. Recent research has suggested a number of options for minimising the risks to biodiversity of forestry operations. The maintenance of extensive conventional national parks and equivalent reserves still constitutes the best option from the purely biological standpoint. However, social, economic and demographic realities coupled with increased knowledge of the ecology and distribution of tropical forest species, suggests that appropriate forestry practice can contribute significantly to biodiversity conservation. The optimal strategy should be based upon a system of conventional protected areas, complemented by a reduction of the impact of harvesting and the retention of unlogged refugia in logged-over-forests.

Scherr, S.J., White, A. and Kaimowitz, D. 2003. ***A new agenda for forest conservation and poverty alleviation: making markets work for low-income producers***. Washington, DC, Forest Trends and CIFOR. 89p. Community based forestry has the potential to contribute much more to achieving sustainable development and poverty reduction than is the case today. This paper describes and analyzes these potentials and demonstrates their feasibility with real world cases of community forest businesses and innovative policies and business partnerships. This preliminary assessment is offered as a first step in a longer-term effort to understand existing forest product and service markets, and to identify the most promising market opportunities for local community producers, focusing particularly on developing

countries. Part I presents the broader context of forestry's changing relation to rural development and poverty reduction. Part II develops a framework for considering which market niches have potential for poor producers. Part III proposes strategies and targeted actions to realize that potential.

Scherr, S.J., White, A. and Kaimowitz, D. 2003. **Making markets work for forest communities**. *International Forestry Review* **5**(1): 67-73.

Shackleton, S., Campbell, B.M., Wollenberg, E. and Edmunds, D. 2002. **Devolution and community-based natural resource management**: **creating space for local people to participate and benefit?**. *Natural Resources Perspectives* (ODI) (76): 1-6.

Shanley, P. and Gaia, G. R. 2002. **Equitable ecology: collaborative learning for local benefit in Amazonia**. *Agricultural Systems* **73**(1): 83-97. Rapid growth of timber, mining and ranching industries in forested areas worldwide often offer small holders opportunities to sell forest resources. Rural communities, however, often have little notion of the market value or economic and ecological consequences of forest transformation. Within such scenarios, the learning process needs to be consciously constructed so as to catalyse new ways of thinking about forest management effectively and quickly. This article describes an ecological research project that integrated data and process-oriented approaches to promote collaborative learning. Results indicate that user-centered approaches are needed to ensure that locally relevant information is generated by scientists, and that learning is catalysed not only among information saturated stakeholders such as policy makers and academics, but also among stakeholders who are directly dependent upon forest resources.

Shanley, P. and Luz, L. 2003. **The impacts of forest degradation on medicinal plant use and implications for health care in Eastern Amazonia**. *BioScience* **53**(6): 573-584. Over the last three decades, forest degradation in the Brazilian Amazon has diminished the availability of some widely used medicinal plant species. Results of a 9-year market study suggest that forests represent an important habitat for medicinal plants used in eastern Amazonia: Nine of the twelve top-selling medicinal plants are native species, and eight are forest based. Five of the top-selling species have begun to be harvested for timber, decreasing the availability of their barks and oils for medicinal purposes. Many of these medicinal plants have no botanical substitute, and pharmaceuticals do not yet exist for some of the diseases for which they are used. Market surveys indicate that all socioeconomic classes in Amazonia use medicinal plants because of cultural preferences, low cost, and efficacy. Degradation of Amazonian forests may signify not only the loss of potential pharmaceutical drugs for the developed world but also the erosion of the sole health care option for many of Brazil's rural and urban poor.

Shanley, P., Luz, L. and Swingland, I. R. 2002. **The faint promise of a distant market: a survey of Belém's trade in non-timber forest products**. *Biodiversity and Conservation* **11** (4): 615-636. Increased trade in non-timber forest products (NTFPs) has been promoted as one possible means to slow tropical deforestation by increasing the economic value of intact forest. A market survey of NTFPs occurring in the Capim River basin in eastern Amazonia, Brazil demonstrated that the reality for many smallholder communities in frontier and remote regions includes chronic transportation difficulties, high variability in fruit production, perishable products and lack of market expertise. In some communities, declining abundance of NTFPs due to logging and fire has resulted in a lack of forest products to even meet

subsistence needs. In areas close to cities where transportation is assured and where forest clearing has eroded the natural occurrence of some valuable native NTFPs, smallholders who manage and successfully market native fruit and medicinal species are overcoming these obstacles. In frontier regions undergoing rapid transformation, however, decline in locally used and regionally marketed NTFPs currently pose detrimental consequences for communities. Findings suggest that an overemphasis on NTFP marketing has diverted attention from local livelihood, resource access and subsistence issues.

Sheil, D. 1999. **Developing tests of successional hypotheses with size-structured populations, and an assessment using long-term data from a Ugandan rain forest**. *Plant Ecology* **140** (1): 117-127. In 1947, W. J. Eggeling published an account of forest succession at Budongo, Uganda. This interpretation was based on a large-scale comparative plot study, performed in the 1930s and 1940s. This account, with its implication that species richness declines in late succession, endures as a controversial corner-stone in theories and disputes about community diversity. Data have now been collected over six decades from five of Eggeling‘s original plots. This paper evaluates Eggeling‘s successional interpretation of the Budongo vegetation. The first set of analyses assesses the consistency of the original data with the predictions of compositional progression and convergence implicit in Eggeling‘s model. The second analyses do the same for the time-series observations. A logical approach shows how temporal information may be derived from both between plot, and within plot, evaluations using size-structured data. A Detrended-Correspondence-Analysis (DCA) of canopy-tree composition, from the original data, ranks the plots in perfect correspondence to Eggeling‘s successional sequence. A ’development-scoring‘ procedure is developed using passive-ordination against this sequence; this is then applied to composition by plot and stem-size class. Eggeling‘s original data are consistent with each prediction assessed. The analyses show compositional progression and apparent convergence across the plot series, and also progression and convergence within each plot. A monodominant-Cynometra forest is the natural end-point of this progression. The time-series results, though in apparent agreement for one early successional plot, do not generally accord with Eggeling‘s ideas. The analyses illustrate a general means for evaluating explicit and implicit compositional trends in communities with structured populations.

Sheil, D. 1999. **Tropical forest diversity, environmental change and species augmentation: after the intermediate disturbance hypothesis**. *Journal of Vegetation Science* **10**(6): 851-860. It is not simple to predict how environmental changes may impact tropical forest species diversity. Published hypotheses are almost invariably too incomplete, too poorly specified and too dependent upon unrealistic assumptions to be useful. Ecologist have sought theoretical simplicity, and while this has provided many elegant abstract concepts, it has hindered the attainment of more practical goals. The problem is not how to judge the individual hypotheses and arguments, but rather how to build upon and combine the many hard-won facts and principles into an integrated science. Controversy is inevitable when the assumptions, definitions and applications of a given hypothesis are unclear. Elegance, as an end in itself, has too often been used to justify abstract simplification and a lack of operational definition. Clarifying and combining hypotheses while avoiding assumptions provides a potentially more useful, if less elegant, standpoint. An appraisal of Connell's intermediate disturbance hypothesis, and its application to long-term observations from a Ugandan forest illustrates these concerns. Current emphases encourage ecologists to exclude consideration of environmental instability and non-pristine ecosystems. In reality, many environmental changes and ecological processes contribute to both the accumulation

and erosion of diversity, at all spatial and temporal scales. Site histories, contexts, long-term processes, species-pool dynamics, and the role of people require greater emphasis. These considerations reveal that many environmental changes, even those associated with degradation, can lead to a transient rise in species densities. Drawing on related studies, such as forest yield prediction, suggests that the formulation and calibration of simulation models provides the most tractable means to address the complexity of real vegetation. Simulation-based approaches will become increasingly useful both in unifying the study of vegetation dynamics and in providing improved predictive capacity. Quantification of the processes, scales and sensitivities of the dynamics of tropical forest communities remains a major challenge.

Sheil, D. 2001. **Conservation and biodiversity monitoring in the tropics: Realities, priorities, and distractions**. *Conservation Biology* **15** (4): 1179-1182. Monitoring and research activities may hinder rather than improve conservation in tropical countries. Those concerned with conservation—particularly academics and aid agencies—too often overlook the practical realities of achieving conservation in the tropics. As a result, many initiatives divert scarce resources away from fundamental management priorities. I identify some critical threats to biodiversity and emphasize the limited resources for defending against them. I then define practical conservation priorities and explain how external agencies can deflect management from addressing these. After outlining some examples, I suggest various contributory factors, and a few common- sense options for improved practice. My views derive principally from protected forests in Africa over the last decade, but the concerns have wider relevance to conservation. There is limited capacity for conservation in many countries, and resources must be allocated effectively if conservation is going to be successful. Research and monitoring activities must also be allocated with sensitivity to local priorities and limitations, especially when local resources are involved. Researchers should ensure that they are familiar with local management issues before they become general advisors on local conservation needs. Protected areas must be managed to protect the values they contain, not to provide statistics.

Sheil, D. 2001. **Long-term observations of rain forest succession, tree diversity and responses to disturbance**. *Plant Ecology* **155** (2): 183-199. The relationship between succession and tropical forest diversity has been much debated. A fundamental disagreement hinges on whether high local species richness is a transient successional property, albeit one that can be maintained by disturbance, or is rather a property of stable late successional communities. This paper addresses this controversy employing a series of long-term permanent sample plot data spanning seven decades. W.J. Eggeling studied the vegetation of Budongo Forest, Uganda during the 1930s and 1940s. He described a series of ten plots (1.4 and 1.86) as a successional progression of forest types in which tree species numbers show a unimodal rise-and-fall over time – a pattern best known from Connell's illustration of his intermediate disturbance hypothesis. Tree communities in five of the original plots have been intermittently re-assessed over the subsequent decades. One data-series provides observations spanning 54-years from one intact ‘undisturbed’ old-growth forest plot. The remaining four plots were assessed before and after controlled disturbances (tree poisoning) executed in the late 1950s and early 1960s, and the resulting data-series span c. 20 years of pre-disturbance and c.35 years of post-disturbance changes. The unimodal pattern of species-richness in the original comparative plot-series is paralleled by a similar rise-and-fall in stem-densities, but rarefaction confirms that the unimodal pattern in richness also holds for fixed stem-counts. The proportion of species occurring in both large and small stem-size-classes increases across

the series. As richness declines in later succession, low abundance species occur predominantly in larger stem-sizes. All time-series show a rise in species richness ranging from 12 to 177% (over 50–60 years). Each of the disturbed plots ultimately reaches greater richness than was recorded anywhere in Eggeling's original series. Contrary to expectation a small rise was also recorded in the undisturbed late successional plot (c.42 species ≥ 10 diameter ha^{-1}, rising to c.47). The lowest species density observed in the study is a 1940s record of c. 10 species ≥ 10 diameter ha^{-1} in monodominant *Cynometra* [Caesalpinoidae] forest and the highest record is c. 61 recorded in 1992, in the youngest vegetation type monitored. These observations indicate both the volatile nature of tree-richness patterns and the limitations of simple models as aids to interpretation when confronted with real patterns of long-term change.

Sheil, D. 2002. **Why doesn't biodiversity monitoring support conservation priorities in the tropics?** *Unasylva* **53**(209): 50-54. Biodiversity monitoring activities can hinder rather than promote conservation in tropical countries. The national institutions responsible for conservation in developing countries have very limited resources, which given donors and richer agencies scope for considerable influence. However, those nominally concerned with supporting conservation often overlook the practicalities. As a result, many initiatives divert scarce resources away from fundamental management priorities. This article addresses the importance of various types of biodiversity monitoring, suggests practical biodiversity conservation priorities and indicates how external agencies can deflect local management from addressing these. The article is an elaboration of opinions published recently (Sheil, 2001), based mainly on author's personal experiences in Africa and South-east Asia. One vital step to addressing the problem is a frank discussion of how conservation goals should be supported.

Sheil, D. 2003. **Observations of long-term change in an African rain forest**. *Tropenbos Series* **22,** The Tropenbos Foundation, Wageningen, Netherlands, pp. 37-59. This account summarizes studies based on tree data from plots established during the 1930s and 1940s in Budongo, a Ugandan rain forest. The original interpretations of forest change provoked controversies that continue to the present day. Analyses have yielded three categories of results: the first is descriptive; the second is a more focused evaluation of the relationship between forest change and species persistence; and the third is methodological. This summary focuses on the first two by examining stem, species and stand level patterns of change and introduces some previously unpublished results relating to trends in species traits and characters. Evidence confirmed the successional nature of the original series of plots. However, the time series changes were complex and while the younger vegetation plots developed more or less as expected the older plots did not. Disturbances caused by silvicultural intervention in four of the five longer-term plots compromised some evaluations, but also allowed the effects of such disturbances to be observed. Various anticipated aspects of forest change were verified. Examples included the slowing of forest dynamics with maturity, and the increase in potential canopy height. However, other observations, such as the real-time increase in tree recruitment were less expected and require explanation. Viewed overall, the results suggest an interplay of many factors that must be explored in greater depth. The importance of truly long-term studies is highlighted.

Sheil, D. and Burslem, D. F. R.P. 2003. **Disturbing hypotheses in tropical forests**. *Trends in Ecology & Evolution* **18**(1): 18-26. The intermediate disturbance hypothesis (IDH) is a controversial explanation for the maintenance of tropical forest tree diversity, but empirical

tests of it are rare. Two data-intensive evaluations have recently yielded contradictory outcomes: one for and one against the IDH. Authors propose that the explanation for these results lies in the subtleties of divergent interpretations and approaches, and in the different characteristics of the study sites. The apparent simplicity of the IDH is deceptive, because a range of distinct phenomena is involved, each of which can be defined and examined. Recent developments offer exciting opportunities for a deeper comprehension of how disturbance influences forest diversity.

Sheil, D. and Heist, M. van. 2000. **Ecology for tropical forest management**. *International Forestry Review* **2**(4): 261-270. There is a considerable body of ecological information relevant to the management of tropical forests, but in practice, little of this is used. Article demonstrates how ecology helps us understand forests and forest change and argue an urgent need for a wider appreciation and utilization of current knowledge. Authors illustrate how forest managers must take a holistic, long-term landscape-level view, and how change in itself is inevitable. Authors start by considering familiar concerns relating to silviculture and canopy disturbance. From this basis, authors move into the neglected biology of tree pollination and seed dispersal and the risks associated with animal loss. Authors identify the increasing threats from fire, exotic species, and habitat fragmentation. Finally, authors consider the difficult balance between timber production and conservation related values. Authors then suggest how our ecological overview, with its mixture of common sense and more subtle insights, might be translated into beneficial actions and conclude that considerable progress is attainable, but requires collaboration between ecologists and forest managers. Initiatives that seek to reform forest practices in the tropics require a sound ecological basis to better address the many challenges facing modern forestry in these regions - such a basis is, in large part, already available for wider use. Authors provide some illustrations as to how management may be improved. Fundamental to this is the recognition that ecological knowledge is crucial to forestry but currently often ignored, and that considerable and rapid progress is possible if ecologists, foresters, and others can find ways to work together and address this directly.

Sheil, D. and S. Wunder. 2002. **The value of tropical forest to local communities: complications, caveats, and cautions**. *Conservation Ecology* **6**(2): 9. [online] URL: http://www.consecol.org/vol6/iss2/art9 The methods used to value tropical forests have the potential to influence how policy makers and others perceive forest lands. A small number of valuation studies achieve real impact. These are generally succinct accounts supporting a specific perception. However, such reports risk being used to justify inappropriate actions. The end users of such results are rarely those who produced them, and misunderstanding of key details is a concern. One defense is to ensure that shortcomings and common pitfalls are better appreciated by the ultimate users. In this article, authors aim to reduce such risks by discussing how valuation studies should be assessed and challenged by users. Authors consider two concise, high-profile valuation papers here, by Peters and colleagues and by Godoy and colleagues. Authors illustrate a series of questions that should be asked, not only about the two papers, but also about any landscape valuation study. Authors highlight the many challenges faced in valuing tropical forest lands and in presenting and using the results sensibly, and offer some suggestions for improvement. Attention to complexities and clarity about uncertainties are required. Forest valuation must be pursued and promoted with caution.

Sheil, D., Ducey and M. J. 2002. **An extreme-value approach to detect clumping and an application to tropical forest gap-mosaic dynamics**. *Journal of Tropical Ecology* **18**: 671-686. Although forest tree pattern-dynamics has long been a focus for ecological theory, many aspects of basic analysis remain problematic. This paper describes, examines and illustrates an 'extrem-value' approach to clump detection. Simulations demonstrate that the approach, though simple, is sensitive and well suited to identifying aggregation, even in small data sets. Though powerful, the extreme-value tests are slightly conservative. The approach is adaptable to other null distributions and applications. An illustration uses tree data from a Ugandan forest plot with records from 1939 to 1992. One plausible explanation for observed stem increases in this plot is an unusually high incidence of large tree-fall events. Evidence for this is sought through spatial localization of various stem populations. Various technical and ecological aspects of the extreme-value approach and tree spatial analyses are discussed.

Sheil, D., Ducey, M. J., Sidiyasa, K. and Samsoedin, I. 2003. **A new type of sample unit for the efficient assessment of diverse tree communities in complex forest landscapes**. *Journal of Tropical Forest Science* **15**(1): 117-135. Authors present a new and versatile sample unit suitable for rapid assessment of tropical forest in heterogeneous areas. The method uses multiple applications of small and easy-to-apply variable-area subunits, in which the area is defined by simple and objective rules. Compared with any fixed-area approach, the sample unit is quick and easy to apply even in difficult terrain, and the amount of information collected varies little with stem densities. Unlike most variable-area methods difficult judgements are rare. Further, it cannot be extended to arbitrary size, but remains compact, allowing data to be linked to local-site variables. Useful data will generally result even in patchy and divided environments. Here authors describe the method, discuss the nature of the resulting data and show how various stand characters can be calculated. The calculation of basic stand parameters from the sample data does not require any sophisticated analyses, and some worked examples are provided to ensure that the calculations are accessible. To demonstrate the statistical theory underlying this class of methods, and the good performance of the estimation methods, a more formal theoretical treatment is included as an appendix. The approach offers considerable promise for efficient forest assessments.

Sheil, D., Nasi, R. and Johnson, B. 2004. **Ecological criteria and indicators for tropical forest landscapes: challenges in the search for progress**. *Ecology and Society* **9**(1): 7. [online] URL: http://www.ecologyandsociety.org/vol9/iss1/art7. In the quest for global standards, "Criteria and Indicators" (C&I) are among the foremost mechanisms for defining and promoting sustainable tropical forest management. This paper examines some challenges posed by this approach, focusing on examples that reflect the ecological aspects of tropical forests at a management-unit level and assessments such as those required in timber certification. C&I can foster better forest management. However, there are confusions and tensions to reconcile between general and local applications, between the ideal and the pragmatic, and between the scientific and the democratic. To overcome this requires a sober appraisal of what can realistically be achieved in each location and how this can best be promoted. Good judgment remains the foundation of competent management. Data can inform this judgment, but an over-reliance on data collection and top-down bureaucratic interventions can add to problems rather than solving them. These arguments stress compromise, planning, guided implementation, and threat preparedness. Importance is also placed on skills and institutions: the building blocks of effective forest management. The authors suggest some options for improving forest management. Although a wider discussion of these issues is necessary, procrastination is harmful. Action is needed.

Sheil, D., Sayer, J. A. and O'Brien, T. **Tree Species Diversity in Logged Rainforests**. *Science* **284**: 1587a. Report about increase in tree diversity 8 years after selective logging in Borneo is challenged. Periods as short as 8 years actually tell us little about the long-term maintenance of species in managed systems where some stems have the potential to live for centuries. While production forests have numerous conservation values, any benefits from post-logging increases in tree diversity remain doubtful.

Silva, E., Kaimowitz, D., Bojanic, A., Ekoko, F., Manurung, T. and Pavez, I. 2002. **Making the law of the jungle: the reform of forest legislation in Bolivia, Cameroon, and Indonesia**. *Global Environmental Politics* **2**(3): 63-97. The debates over sustainable development put environmental issues squarely on the policy agendas of nations around the world. Throughout, the fate of the forest occupied center stage, and domestic and international pressure induced many developing nations to reform their forest policy, which frequently culminated in new forest legislation. Yet the process that generated those new forest laws has not received much attention and a number of questions remain unanswered. What factors determine whether governments reform forest laws in the first place? What conditions influence the direction of reform? What role does expert advice play in the process? This paper applies a political economy framework that focuses on the interplay between international structure, domestic structure and ideas to answer those questions. It argues that this approach offers the best tools for analyzing the actors and interests involved in the policy process and their power resources. Among the most significant findings are that the World Bank is not as influential in the end as is commonly perceived. Moreover, in democratic developing countries organizations that focus almost exclusively on cultivating their relationship with state ministries to influence forest policy reform usually see their efforts flounder because the legislature, especially legislative committees, is a more significant policy making arena than had been considered here before.

Singh, K.S. 2001. **Gender roles in history: women as hunters**. *Gender, Technology and Development* **5**(1): 113-124. The traditional anthropological view of man as the sole hunter is being questioned today and women's role in hunting is being highlighted. The evidence from India supports the view of women as hunters, no matter how restricted this role may be. The archaeological evidence shows that hunting involved women-men partnerships. Folklore and puranic myths represent mother goddesses as killers of major wild animals. There are many historical examples of queens shooting tigers and panthers. In the colonial period when shooting a tiger became a status symbol, there were sportswomen, both Indian and British, who shot major mammals. Also, women from rural and indigenous communities, with their simple instruments and techniques, killed major mammals to save life and property. A unique tribal hunt that survives as a remnant of women's role as hunters is known as jani shikar, held every 12 years by indigenous women when they go out to hunt wild animals, mainly minor ones today as ideas of conservation seep in. Thus, in spite of general reservations about and prohibitions on women, there is still a role for women in hunting.

Sist, P. and Saridan, A. 1999. **Stand structure and floristic composition of a primary lowland dipterocarp forest in East Kalimantan**. *Journal of Tropical Forest Science* **11**(4): 704-722. The structure and species composition is described of the primary lowland dipterocarp forest in Berau, East Kalimantan, Indonesia, based on a study of 3 undisturbed forest plots, 4 ha each, totalling 12 ha, where 93% of the trees (dbh more than or equal to 10 cm) were identified at the taxa level. The density, basal area and standing volume were on average, and respectively, 521 trees ha^{-1}, 31 m^2 ha^{-1} and 383 m^3 ha^{-1}. The dipterocarps

represented about 25% of the tree population, 50% of the basal area and 60% of the standing volume. In primary forest 538 different taxa were recognised representing a mean of 182 tree species per ha. The families Dipterocarpaceae and Euphorbiaceae were the main important taxa in both density and number of species (61 species each). The structure of the forest at Berau is very similar to that in Sabah or other parts of Northern Borneo. However, the main characteristic of this forest is its remarkable richness in dipterocarps, in comparison with the northern parts of Borneo; the forest has a mean of 29 species ha^{-1} and 61 species for the 12 ha surveyed. The Sabah forests are mainly dominated by light-demanding dipterocarp species such as *Parashorea* spp. and *Dryobalanops* spp. This could result from important canopy disturbances caused by climatic events like long periods of drought or cyclones. The high species richness of the Berau forest may be linked to a longer stability and a relative constancy of the climate in the region. The hypothesis of a possible impact of drought events on the forest dynamics and consequently on species distribution and richness in Borneo is discussed. However, it is stressed that the lack of data for Kalimantan is undoubtedly an handicap for the analysis of phytogeographical variations within the region. In the study area, the first record for Indonesia of the 2 dipterocarp species *Shorea leptoderma* and *Shorea symingtonii* demonstrates that knowledge of the flora of Kalimantan is still to be improved.

Sist, P., Fimbel, R., Sheil, D., Nasi, R. and Chevallier, Marie-Hélène. 2003. **Towards sustainable management of mixed dipterocarp forests of Southeast Asia: moving beyond minimum diameter cutting limits**. *Environmental Conservation* **30**: 364-374. Selective logging applied in tropical forests is based on one universal criterion: a minimum diameter cutting limit for all commercial timber species. Minimum diameter cutting limits in mixed dipterocarp forests of the Malesia region lead to high felling intensities (10-20 trees per ha). Such extraction rates create massive stand damage (50% of the remaining tree population), which has a negative impact on the regeneration and growth of many harvested dipterocarp species. As such, the minimum diameter cutting limit approach is seldom compatible with sustainable forest management. Where basic ecological characteristics of the commercial species are considered in timber harvesting prescriptions, mixed dipterocarp forests appear capable of sustained timber yields, habitat conservation, and providing other goods and services. This paper first presents the main silvicultural systems developed in mixed dipterocarp forests of Western Malesia and then reviews current knowledge of dipterocarp biology to finally develop guidelines aimed at improving the ecological sustainability of production forests of Western Malesia. These guidelines, a pragmatic reflection of science and 'best guess' judgement, include: (1) integration of reduced-impact logging practices into normal management operations; (2) cutting of eight trees ha_1 or less (with a felling cycle of 40-60 years to be determined according to local conditions); (3) defining minimum diameter cutting limits according to the structure, density and diameter at reproduction of target species; (4) avoiding harvesting species with less than one adult tree per ha (diameter at breast height [dbh] 50cm over an area of 50-100 ha); (5) minimizing the size and connectivity of gaps ($600m^2$ whenever possible); (6) refraining from treatments such as understorey clearing; and (7) providing explicit protection for key forest species and the ecological processes they perform. Further refinement is encouraged to allow for local conditions, and for other forest types.

Sist, P., Sheil, D., Kartawinata, K. and Priyadi, H. 2003. **Reduced-impact logging in Indonesian Borneo: some results confirming the need for new silvicultural prescriptions**. *Forest Ecology and Management* **179**(1-3): 415-427. Reduced-impact logging (RIL) and conventional techniques (CNV) were compared in a mixed dipterocarp hill forest

in East Kalimantan in three blocks of about 100 ha each. Damage was evaluated using pre- and post-harvesting assessments in 24 one-hectare sample plots. RIL techniques nearly halved the number of trees destroyed (36 vs 60 trees/ha). RIL's main benefit was in the reduction of skidding damage (9.5% of the original tree population in RIL vs 25% in CNV). Before logging, mean canopy openness in CNV (three plots only) and RIL (9 plots) was similar (3.6 and 3.1%) and not significantly different ($\chi 2=2.73$, $P=0.254$). After logging, the mean canopy openness was 19.2% in CNV ($n=9$ plots) and 13.3% in RIL ($n=8$ plots), and the distributions of the canopy class in RIL and CNV significantly different ($\chi 2=43.56$, $P<0.001$). CNV plots showed a higher proportion of measurements in the most open class $\geq$ 30% than in RIL. At a larger scale, the area of skidtrail per unit timber volume extracted was halved in the RIL compartment (15 m2 vs 27 m2 m-3 for CNV). However, under high felling intensity (>8 trees/ha), both stand damage and canopy disturbance in RIL approached those recorded in CNV under low or moderate felling regime. Over this felling intensity threshold the effectiveness of RIL in reducing tree damage is limited. In mixed dipterocarp forest where harvestable timber density generally exceeds 10 trees/ha, a minimum diameter felling limit is clearly insufficient to keep extraction rates below 8 trees/ha. Based on these new results and previous studies in Borneo, authors suggest three silvicultural rules: (1) to keep a minimum distance between stumps of ca. 40 m, (2) to ensure only single tree gaps using directional felling, (3) to harvest only stems with 60–100 cm dbh. Foresters, policy makers and certifiers should consider these as criteria for sustainable forest management. Authors emphasise the need to expand harvesting studies to look at impacts and trade-offs across larger forest landscapes, to expand RIL beyond silvicultural concepts and to include the maintenance of other forest goods and services.

Smith , J., Ferreira, S., van de Kop, P., Ferreira, C. P., Sabogal, C. 2003. **The persistence of secondary forests on colonist farms in the Brazilian Amazon**. *Agroforestry Systems* **58** (2): 125-135. While slash-and burn farmers convert forest to agriculture, they also regenerate significant areas of secondary fallow forests on their farms. Under what conditions does secondary forest cover persist on slash-and-burn farms? Survey data from Pará, Brazil show that secondary forests occupy 20% of farm area even after a century of settlement. In addition to restoring soil fertility, secondary forests contribute over 20% of farmers' income through products such as charcoal, fruit, game animals and firewood for on-farm processing. Econometric analysis shows that slow rates of population growth and increases in agricultural incomes through on-farm processing of agricultural products enable farmers to maintain long fallows and result in diversified systems compatible with secondary forest cover in the study area. On the other hand, declining agricultural productivity, subsidized credit, declines in the growth rate of secondary forests and policies favoring speculative land acquisition threaten secondary forest persistence. In older settlement areas, secondary forests are often the only forest resource available to the rural poor. Fallow areas should therefore be managed not only for agricultural productivity, but also for conserving forest resources.

Smith, J. 2002 **Afforestation and reforestation in the clean development mechanism of the Kyoto Protocol: implications for forests and forest people**. *International Journal of Global Environmental Issues* **2**(3/4): 322-343. The social and environmental implications of plantations in the CDM are analysed under a hypothetical laissez faire approach and a proactive approach to sustainable development (SD), bounded by existing COP7 agreements and efficiency and equity considerations. Implications for timber rich, timber depleted and inherently timber poor regions are assessed. The social risks of industrial plantations cannot fully addressed under COP7 rules and are likely to be highest in timber rich regions under

repressive regimes or where politics dominate the forestry sector. Risk could, however, be reduced through minimum standards for stakeholder consultation and favourable legal institutions. Low cost opportunities with multiple benefits exist and require information dissemination, but some opportunities for biodiversity benefits will need financial support. Reduction of transaction costs would increase the participation of small holder plantations but their role is likely to remain limited. Inclusion of assisted natural regeneration opens up opportunities for options with multiple benefits.

Smith, J. and Applegate, G. 2004. **Could payments for forest carbon contribute to improved tropical forest management?** *Forest Policy and Economics* **6**(2): 153-167. Under the Kyoto Protocol industrialized countries will be able to meet carbon emission reduction commitments by financing forestry projects that sequester carbon in developing countries. While this mechanism would compensate for missing markets in forest environmental services, it could also enable industrialized countries to avoid reducing energy use. This paper assesses whether such projects could contribute to improved logging practices in the tropics. Results from studies primarily in Asia and Latin America are analyzed in the context of the modalities of the Kyoto Protocol. Results show that the opportunity cost of shifting from conventional logging to improved practices may have been underestimated. At the same time the long-term carbon and biodiversity benefits of improved forest management may have been underestimated. These results follow primarily from the fact that most previous studies assume that a permanent forest estate is maintained under conventional logging and that cutting cycles are as long as 30–60 years. A more realistic scenario, however, consists of repeated harvesting at short intervals during the first few decades, resulting in the degradation of the forest into shrub and grassland. The implications of these results are that forest management projects may be less cost-effective than previously assumed. Therefore, expectations about their potential contribution to improved management should be scaled down. At the same time, the extent to which such projects will enable industrialized countries to avoid reducing industrial pollution is also unlikely to be significant. Cost-effectiveness is likely to be highest where timber volumes in the first few decades after initial logging are comparable under conventional and improved logging. This is likely where topography is relatively flat, biodiversity values are low, wastage of felled timber is high and the policy environment is favorable. A number of proactive measures are suggested to expand the niche for forest management carbon projects. These measures are justified because the incremental carbon and biodiversity benefits in the long run may be higher than previous studies have indicated.

Smith, J. and Scherr, S. J. 2002. ***Forest carbon and local livelihoods: assessment of opportunities and policy recommendations***. CIFOR Occasional Paper No.37, Center for International Forestry Research (CIFOR), Bogor, Indonesia, 45 pp. Projects implemented as part of the Clean Development Mechanism (CDM) of the Kyoto Protocol will have the dual mandate of mitigating greenhouse gas emissions and contributing to sustainable development. Basic agreement on core elements was reached in 2001, including the decision to allow afforestation and reforestation projects. However, it is not yet clear what rules will address social concerns. Many types of projects could potentially contribute to local livelihoods and ecosystem restoration, as well as to carbon emission offsets, including those using natural forest regeneration, agroforests, improved forest fallows and agroforestry. Averted deforestation projects with multiple-use forestry, though not eligible in the first CDM period, could be reconsidered in the future. Such projects can be designed to rigorously meet CDM criteria for carbon impact, additionality, leakage and duration. If suitably targeted,

they can be cost-effective for investors in terms of production costs. Some, however, may have higher transaction costs. Proactive efforts are needed to enable community-based CDM forestry projects and local land uses to compete effectively in carbon trading markets with projects managed by large-scale operators. The CDM should require mandatory social impact assessments, harmonise the CDM with social principles of other global conventions, promote measures to reduce transaction costs and explicitly include assisted natural regeneration and forest rehabilitation in the definition of afforestation and reforestation. Most developing countries will require policy action to establish the enabling conditions for forest carbon projects to contribute on a large scale to local livelihoods, integrate CDM projects within national development frameworks, attract investors, establish social criteria, secure local rights and promote support services for local people. Cost-effective project design requires attention to local participation, transparency, suitable compensation mechanisms, strategies to reduce transaction costs and risks and extend the scale of projects, and to enhance profitability of land uses.

Smith, J. and Scherr, S. J. 2003. **Capturing the value of forest carbon for local livelihoods**. *World Development* **31**(12): 2143-2160. Authors contribute to the debate on the social implications of carbon forestry projects by showing that tradeoffs exist between social benefits of projects and their cost-effectiveness. Large-scale industrial plantations and strict forest protection are economically viable, but pose the highest social risks. Socially beneficial projects are less cost-effective because of their higher transaction costs. Enabling policies are also required for their success. Regulation of carbon markets will therefore be required to reduce social risks and enhance benefits. Authors propose a number of regulatory and proactive measures and justify them on the basis of market imperfections and concepts of sustainable development.

Smith, J., Cadavid, J.V., Ayarza, M., Pimenta de Aguiar, J. L. and Rosa, R. 1999. **Land use change in soybean production systems in the Brazilian Savanna: The role of policy and market conditions**. *Journal of Sustainable Agriculture* **15**(2-3): 95-117. This paper analyzes land use change in the Brazilian savanna and draws out policy implications about the adoption of resource management technologies. Resource management technologies are more likely to be adopted in areas experiencing a long-term deterioration in market conditions. Adoption occurs primarily to increase long-term economic viability. Thus adoption may coexist with adverse environmental and social impacts. Past opportunities for asset accumulation appear to be a pre-condition for adoption, indicating the importance of building up the resilience of farmers (particularly the resource-poor) during good times. Partnerships with the private sector can contribute significantly to technology diffusion.

Smith, J., Mulongoy, K., Persson, R. and Sayer, J. 2000. **Harnessing carbon markets for tropical forest conservation: Towards a more realistic assessment**. *Environmental Conservation* **27**(3): 300-311. The proposed Clean Development Mechanism (CDM) of the Kyoto Protocol paves the way for financial and technological transfers to support forestry projects that sequester carbon or protect carbon stocks. From its inception, the concept has been highly controversial. It has been enthusiastically supported by those who believe that conservation of tropical forests will be difficult unless forest owners and managers are compensated for the environmental services of their forests. Others believe that financial transfers supporting 'carbon farming' would ignore social concerns and the full range of goods and services of forests. This paper examines the implications of CDM for forest conservation and sustainable use, by drawing on recent literature and the results of a policy

dialogue with CDM stakeholders. Authors conclude that initial estimates of the contribution tropical forestry could make to both climate change mitigation and to forest conservation need to be scaled down. CDM payments for tropical forestry are likely to be received in a far more limited area than initially expected. The cost-effectiveness of forestry projects relative to projects in the energy sector may have been overestimated. In particular few estimates have adequately accounted for the likelihood that the duration of CDM forestry projects is unlikely to be as long as the residency time of carbon in the atmosphere. Also political realities and investor priorities may not have been sufficiently understood. CDM funding for forestry may also decline in future as economically viable clean technologies are increasingly developed in the energy sector. Tropical forests are likely to be an intermediate climate change mitigation strategy for buying time, until more permanent options become available. The most important justification for including forests in CDM may lie in the contribution CDM could potentially make to forest conservation and sustainable use. An analysis of the implications of CDM for forests reveals the importance of involving forest stakeholders more closely in the CDM debate. To prevent perverse outcomes and reduce the risk of 'leakage' of emission reduction to areas outside project boundaries, CDM projects may need to be limited to niches which meet certain political and institutional preconditions and where sufficient understanding of local decision-making and the broader context is available, CDM may be more effective if used to remove non-economic impediments to forestry activities that are economically viable and meet local needs. Lessons from the forestry sector in relation to plantations, natural forest management, forest conservation and non-timber forest products are discussed to illustrate the dangers of misusing CDM and also to give examples of how CDM could be harnessed for better use of forests. CDM should be seen as one more tool for enhancing the effectiveness of more conventional ways of promoting forest conservation and sustainable use.

Smith, J., van de Kop, P., Reategui, K., Lombardi, I., Sabogal, C. and Diaz, A. 1999. **Dynamics of secondary forests in slash-and-burn farming: interactions among land use types in the Peruvian Amazon**. *Agriculture, Ecosystems & Environment* **76**(2-3): 85-98. The regeneration of secondary forests (SF) on previously cleared land in the Amazon is a promising development within the generally pessimistic scenario about tropical deforestation. This has stimulated efforts to augment the value of SF to farmers to induce them to increase the area in SF. The objective of this paper was to document the regeneration of SF in slash-and-burn agriculture and to develop policy and technological recommendations for conserving forest cover on small farms and improve farmer welfare. The dynamics of SF in slash-and-burn farming were studied by investigating changes in the role of SF with frontier development. Farm survey data from a colonist settlement area in the Peruvian Amazon were analyzed by using a recursive econometric model. Results confirmed that substantial areas of SF exist on slash-and-burn farms during the first few decades after settlement. As a result, over a third of the farm area is under forest cover. This implies that deforestation in slash-and-burn farming may be less than previously believed. Soil recuperation is the most important reason for the existence of SF in slash-and-burn agriculture. During the relatively early stages of frontier development studied in this paper, fallow periods increased over time as site productivity declined, giving rise to secondary forests. Pastures lowered forested areas on farms and appear to impede the regeneration of SF. Commercial exploitation of SF products was minimal and declines with frontier development. The conclusions show that improved short-rotation fallows may recuperate the soil at the expense of forest cover, particularly in areas where most of the forest cover consists of SF. This conflict could be resolved by technologies that enrich SF and reinforce its multiple functions, including soil

recuperation. Reduction of extensive cattle ranching may be a more effective way to conserve forest cover in slash-and-burn farming than technologies for shortening fallow periods. A `quantum leap' in the benefits of forested land will be required if increases in forest cover are to be compatible with farmer welfare. This is likely to require innovative approaches, such as commercialization of the environmental services of forests. The results of this research could potentially shift efforts to control deforestation away from slash-and-burn farmers, thus reducing the perceived conflict between forest conservation and the livelihood of poor people.

Snook, L. K. and Negreros-Castillo, P. 2004. **Regenerating mahogany (*Swietenia macrophylla* King) on clearings in Mexico's Maya forest: the effects of clearing method and cleaning on seedling survival and growth**. *Forest Ecology and Management* **189** (1-3): 143-160. To mimic catastrophic disturbances which have favored the establishment of natural stands rich in mahogany (*Swietenia macrophylla*), two 5000 m2 clearings were established in each of four locations using each of three treatments: complete felling; slashing, felling and burning; and machine-clearing, which uprooted all prior vegetation. One to three months later, and again after an additional 12 months, twenty 4-month-old mahogany seedlings were planted in the center of each clearing, and, simultaneously, nearby, under the forest canopy. One year after the first planting and again 7 months later, vines and competing vegetation were cleaned from around the seedlings on one of each type of clearing in each location. Fifty-eight months later, only 5% of mahogany seedlings survived under the canopy, as compared to 32% on felled clearings and 50% on burned or machine-made clearings. Average annual growth of seedlings planted the year clearings were opened was approximately double that of seedlings planted a year later, after natural regeneration of other species had become established. At 58 months uncleaned trees averaged 352 cm in height (and the tallest 600 cm) on burned clearings, 324 cm on machine-made clearings, and 195 cm on felled clearings. Surviving seedlings planted under the forest canopy had grown less than 30 cm during the same period. On burned and machine-made clearings the effect of cleaning on growth was not statistically significant, but on felled clearings cleaning increased growth by 120%, to rates similar to those on burned clearings. Attack by the *Hypsipyla grandella* shootborer was significantly affected by cleaning. After 58 months, only 12% of seedlings on uncleaned plots had been attacked, compared to 44% of seedlings on cleaned plots. Cleaning also significantly increased vines, particularly on seedlings planted the year after clearings were created: 36% of all seedlings on cleaned plots had vines, as compared to 19% of uncleaned seedlings. In summary, planting mahogany seedlings under the forest canopy cannot be expected to regenerate mahogany trees. However, mahogany seedlings survive and grow well on clearings, with no subsequent interventions, if planted shortly after these are opened by machine or burning. This approach to regeneration could be expected to yield densities of 100 commercial-sized mahogany trees/ha among a matrix of 400 naturally regenerated trees/ha of other species. At this rate, regenerating mahogany on clearings equivalent to 3% of the annual cutting area intervened at each harvest, could provide for replacement of mahogany trees harvested from the permanent forest reserves in the region.

Spilsbury, M. J. and Kaimowitz, D. 2000. **The influence of research and publications on conventional wisdom and policies affecting forests**. *Unasylva* **51**(203): 3-10. An analysis based on a survey of forestry experts and a theoretical review suggests that research influences policy in an indirect way, although traditionally it was believed that research influenced policy directly.

Spilsbury, M. J. and Kaimowitz, D. 2002. **Forestry research, innovation and impact in developing countries - from economic efficiency to the broader public good**. *Forestry Chronicle* **78**(1): 103-107. This paper applies a broad-brush perspective to forestry research, innovation and research capacity in developing countries and the impacts linked to it. The authors reflect upon successes and failures in the hope of improving the focus and relevance of future efforts and highlight emerging research approaches aimed at ameliorating some of the deficiencies. They begin by examining the role of informal research and the emergence of formal research in developing countries. They note that for most of the last century, forestry research was predominantly focused on achieving "efficiency gains" in forest production systems, and that this focus was shared by both private enterprise and prevailing approaches to broader "development" in developing countries. They assert that there has been difficulty in realising research-induced efficiency gains in the developing tropics and suggest that the underlying reasons often relate to insecure land tenure, resource, conflicts, lack of access to capital, large power imbalances and corruption within society. Changing research priorities are increasingly directed towards improvement of rural livelihoods in the context of sustainable resource management. They observe that forestry-related research capacity in developing countries is weak and under-resourced and there is commonly a mismatch between the skills available in the "installed capacity" of public sector research institutions and those required for the topics that have the highest potential to generate public goods. The authors propose that the focus should place a greater emphasis on policy research to relieve the constraints highlighted above and believe that impact can be enhanced through integrated "action research" across disciplines, scales and stakeholders.

Sunderland, T. C. H. and Ndoye, O. (eds). 2004. ***Forest products, livelihoods and conservation**: case studies on non-timber forest product systems*, *volume 2 - Africa*. Bogor, Indonesia, CIFOR. xiv, 333 pp. This book contains 17 case studies of non-timber forest products (NTFPs) in Africa. it reveals an ancient system of resources moving through space and time, resources which further enable African people benefit from their marketing capacity locally. As these case studies show, establishing or strengthening markets for NTFPs can help to encourage renewable resource conservation and can contribute significantly to rural livelihoods. However, for NTFP extraction to 'save' large tracts of forests will have to be resolved, just as it must be resolved if eco-tourism, selective logging or any other economic activity is to be conducted in an environmentally sound manner. In addition, attempts to raise the market value of NTFPs, and therefore rural incomes, could be self-defeating if agricultural production of these products originally harvested from the wild is the result. In addition, understanding the political economy is crucial in addressing the economic, social and isntitutional contexts in which NTFPs are harvested and traded. The report are organized to present a standard set of information to support comparative analysis, but the authors also included each detail, idocyncracies and analyses of issues and opportunities in their own cases. Individually, the cases provide a wealth of interesting and useful information.

Sunderlin, W. D. 2003. ***Ideology, Social Theory, and the Environment***. Rowman and Littlefield, 256 pp., [Excerpts from a book review by Richard B. Norgaard in *Ecological Economics* **49**: 410-411, 2004]. William "Sunderlin stresses that political ideologies—class ideology on the left, managerial ideology in the center, and individualist ideology on the right—affect all arguments over the state of the environment and what corrections, if any, are appropriate. The three ideologies, or paradigms, structure the book as he explores the different ways that we argue about how population, the level and distribution of affluence, the multiple dimensions of technology, and culture interrelate with each other and with the

environment. This broad framing allows Sunderlin to review nearly the full range of literature on the sociology of the environment and critical issues of political debate without prejudice. He presents arguments and counter arguments, indeed it is a three-way debate, for managerialists are not simply at the center but a distinct ideology as well. The book clearly lays out the three ideological positions and how they respond to each other on different issues, citing the literature along the way. It is an excellent introduction for getting students to recognize patterns in argumentation rooted in political ideology and to think about their own ideological leanings to help them move beyond them as possible. For ultimately, Sunderlin is interested in less argument and greater synthesis, or at least pragmatism. Improving our relations with nature has been drastically slowed through endless, shallow ideological debate. More recently, in the U.S., and therefore with respect to global environmental problems as well, progress has reversed through the growing dominance of individualist ideological arguments. Sunderlin acknowledges that people are making legitimate points from different positions. Equity, power, the effectiveness of policy instruments, the possibilities for technical solutions in the future all need to be considered. On a case-by-case basis, however, typically one or two arguments from the different ideological positions prove critical, others can be pertinent for fine tuning our response, and some points are absolutely wrong. This book helps us sort them out. In pursuit of a pragmatism beyond shallow ideological debates, Sunderlin also helps us see how scholars and practitioners with particular ideological leanings effectively negate, deny, and ignore the arguments from contrasting ideologies. Here too, Sunderlin's analysis is insightful and constructive. At the same time, differences within Sunderlin's broad categories are not as well documented as they are in more specialized analyses. Of course, many of these differences are merely petty academic debates and can rightfully be ignored".

Sunderlin, W. D. 1994. **Resource decline and adaptation through time: Fishers in San Miguel Bay, Philippines, 1980–1993**. *Ocean & Coastal Management* **25**(3): 217-232. This article examines social conditions in a bay experiencing population growth, gear conflict, overfishing, and general resource decline. Sample surveys of fishing households carried out in 1980 and 1993 in nine villages of San Miguel Bay reveal patterns of continuity and change. The key continuity is sustained overall population growth in fishing villages. Among the key forms of change are those which demonstrate a degree of adaptation to resource decline: decreased participation in fishing; greater reliance of fishing households on nonfishing income; increased dependence on remittances of nonhousehold children; increased participation of women in nonhousehold labor; and dramatic growth in the number of fishing organizations involved in resource management. The findings suggest that resource management policies should be patterned after spontaneous adaptations to resource decline.

Sunderlin, W. D. 1995. **Global environmental change, sociology, and paradigm isolation**. *Global Environmental Change* **5**(3): 211-220. There are three broad categories of thought on how to respond to problems associated with global environmental change: structural economic change and grassroots mobilization; international diplomacy and regime building; and cultural/behavioural transformation. These categories of thought correspond to the classical paradigms of sociology — that is, to the class, managerial, and pluralist perspectives. Many writings on global environmental change adhere to the tenets of one particular paradigm while ignoring, downplaying the significance of, or challenging the tenets of other paradigms. The article discusses the dangers of such compartmentalization and recommends that writers on global environmental change work to cross paradigm boundaries.

Sunderlin, W. D. 1997. **An ex-post methodology for measuring poor people's participation in social forestry: an example from Java, Indonesia**. *Agroforestry Systems* **37** (3): 297-310. One of the key goals of social forestry is to involve the poor as project beneficiaries. It is possible to measure the degree of attainment of this goal by collecting socioeconomic data before and after project implementation. This approach cannot be applied at the many sites where ex-ante data were never gathered. This article proposes a methodology for evaluating the degree of inclusion of the poor in social forestry using ex-post data alone. Longitudinal analysis is approximated through the use of 'slow change' socioeconomic variables and through logistic regression. The methodology is illustrated with data on the Java Social forestry Program.

Sunderlin, W. D. and Pokam, J. 2002. **Economic crisis and forest cover change in Cameroon: the role of migration, crop diversification, and gender division labor**. *Economic Development and Cultural Change* **50**(3): 581-606. Dating from 1986 when a devastating economic crisis began, the rate of deforestation has increased significantly in the humid forest zone of Cameroon. Research was conducted in 1997-98 to know how the crisis has affected socioeconomic conditions, and how these changes have in turn affected forest cover. A survey of 4,078 households in 38 villages tested three hypotheses concerning the effects of the crisis on migration, cropping patterns, and the gender division of labor. Among the key findings are that: (1) on average, population in the villages has grown considerably in response to immigration, slowed rural to urban migration, and recent net "return" migration; (2) there has been a massive turn to production of food crops; (3) new food crop production tended to be at the expense of forest cover because many farmers retained their cocoa and coffee plots; (4) men are now highly involved in the production of food crops; and (5) the amount of forest clearing in 1996 was largely a function of increased food crop production and distance from the capital city. Policy efforts aimed at controlling inappropriate deforestation must recognize that macroeconomic conditions can have an important role in influencing migration, food crop choices, and gender division of labor, which in turn influence forest cover change.

Sunderlin, W. D., 1997. **Deforestation, livelihoods, and the preconditions for sustainable management in Olancho, Honduras**. *Agriculture & Human Values* **14** (4): 373-386. Growth of the national cattle herd is contributing to rapid and inappropriate deforestation in Honduras. Field research was conducted in the Department of Olancho to better understand this problem and to assess the possibilities for local interest in forest protection. A recent upsurge in the profitability of cattle farming bodes badly for the forest, but three countervailing factors could ultimately serve as the basis for community-based forest management. First, area residents have a greater appreciation for the economic and ecological functions of the forest than one might surmise, given the rapid pace of deforestation. Second, timber is a significant source of community income, thus there may be latent incentives to maintain supplies in the long term. Third, some residents will not turn to cattle farming, in spite of its profitability, perhaps because of their dependence on timber marketing. Policies enacted in 1992 undermine these incipient incentives for forest custodianship. Inappropriate deforestation can be lessened through policy reforms that would enable smallholders to conserve and manage their resources over the long-term.

Sunderlin, W. D., Angelsen, A., Resosudarmo, D. P., Dermawan, A. and Rianto, E. 2001. **Economic crisis, small farmer well-being, and forest cover change in Indonesia**. *World Development* **29**(5): 767-782. Field research was conducted on 1,050 Indonesian households

to understand the effects of the Asian economic crisis on the well-being of small farmers outside of Java and on their forest-clearing practices. The main findings are: (a) most farmers perceived themselves as worse off during the crisis than before, challenging the claim that farmers with export income would be better off and (b) forest clearing by farmers increased significantly during the crisis to expand rubber holdings and other tree crops, with the aim of increasing future income security. Among the policy lessons are that crop diversification and targeted aid can minimize impoverishment and avert increased forest clearing following macroeconomic destabilization.

Sunderlin, W. D., Ndoye, O. and Bikié, H. 2000. **Economic crisis, farming systems and forest cover change in the humid forest zone of Cameroon**. *International Forestry Review* **2**(3): 173-181. The rate of forest clearing by small farmers in the humid forest zone (HFZ) of Cameroon increased significantly in a period of economic crisis dating from 1986. A random sample survey of 648 households was conducted in 54 villages in the HFZ to understand the effect of the crisis and of a currency devaluation in 1994 on the practices of small farmers, and the effect of these practices on forest cover change. Three hypotheses were tested concerning: (1) the balance between export crop and food crop production; (2) the degree of market-orientation of food crop production; and (3) the gender division of labour. Among the key results are that: (1) the area of cocoa production has stagnated while that of coffee, plantain and other food crops has tended to increase; (2) food crop production is now more market-orientated; and (3) men are now far more involved in food crop production than in the past. The results corroborate other studies showing that increased deforestation in the HFZ is largely a product of these 3 factors and also of: increased rural population, partly resulting from urban-rural migration; decline of food imports and corresponding increase in food crop production; decreased government subsidies for agricultural inputs; and increased logging. The study concludes that: (1) macroeconomic instability can lead to unforeseen and grave consequences not only for the well-being of farmers but also for efforts to protect remaining tropical forests; and that (2) crop diversification might be one way to help avert future income shocks to farmers and minimize forest clearing activity.

Sunderlin, W. D., Ndoye, O., Bikié, H., Laporte, N., Mertens, B. and Pokam, J. 2000. **Economic crisis, small-scale agriculture, and forest cover change in southern Cameroon**. *Environmental Conservation* **27**(3): 284-290. The rate of forest cover loss in the humid tropics of Cameroon is one of the highest in Central Africa. The aim of the large-scale, two-year research project described here was to understand the effect of the country's economic crisis and policy change on small-scale agricultural systems and land-clearing practices. Hypotheses were tested through surveys of more than 5000 households in 125 villages, and through time-series remote sensing analysis at two sites. The principal findings are that: (1) the rate of deforestation increased significantly in the decade after the 1986 onset of the crisis, as compared to the decade prior to the crisis; (2) the main proximate causes of this change were sudden rural population growth and a shift from production of cocoa and coffee to plantain and other food crops; and (3) the main underlying causes were macroeconomic shocks and structural adjustment policies that led to rural population growth and farming system changes. The implication of this study is that it is necessary to understand and anticipate the undesirable consequences of macroeconomic shocks and adjustment policies for forest cover. Such policies, even though they are often not formulated with natural resource consequences in mind, are often of greater relevance to the fate of forests than forest policy.

Sunderlin, W. D., Resosudarmo, I. A. P., Rianto, E. and Angelsen, A. 2000. ***The effect of Indonesia's economic crisis on small farmers and natural forest cover in the outer islands***. CIFOR Occasional Paper No. 28, Center for International Forestry Research (CIFOR), Bogor, Indonesia, 36 pp. Twenty million people live in or near Indonesia's natural forests. The country's humid tropical forests, among the most extensive remaining in the world, are primarily in Sumatra, Kalimantan, Sulawesi, and Irian Jaya. A devastating regional economic crisis that began in mid-1997 affected Indonesia more strongly than any other country in Asia. A random sample survey of 1050 households was conducted in 6 outer island provinces to understand the effects of the crisis on the wellbeing of forest villagers and on their agricultural and forest clearing practices. In particular, the study sought to understand diverging opportunities introduced by the drastic depreciation of the Indonesian rupiah against the US dollar: on the one hand producers of agro-export commodities could get an income windfall from higher market prices, but on the other hand increased costs of living could neutralize potential income gains. Among the key findings of the research were the following: (1) two-thirds of the study households reported they were worse off and only one-fifth reported they were better off during the crisis than in the year before the crisis; (2) this happened in spite of the fact that three-quarters of study households had export commodity income; (3) clearing of forest land increased slightly in the first year of the crisis and greatly in the second year of the crisis; (4) land was cleared increasingly for export tree crops in sedentary systems and less for food crops in swidden cultivation systems; and (5) those who perceived themselves as worse off or better off were more likely to have cleared land during the crisis, and to have cleared a larger area of land, than those who felt their wellbeing did not change significantly. Contrary to the common assumption that rural Indonesians were generally unaffected by the crisis, forest villagers perceived themselves as worse off during the crisis than before. Moreover, additional pressure has been put on forests, in spite of any conclusions that might be drawn from the turn toward increased sedentary farming during the crisis. Key policy lessons are that: (1) farmers need assistance in diversifying their income sources to help protect them against possible future economic shocks; and (2) there should be greater awareness of how macroeconomic instability can lead to undesirable environmental consequences.

Sunderlin, W.D. 1995. **Managerialism and the conceptual limits of sustainable development**. *Society and Natural Resources* **8**: 481-492. The article examine the concept of sustainable development in terms of the three classical sociological paradigms--that is, the class, managerial and pluralist traditions. In so doing, it is discovered that the concept of sustainable development is firmly rooted in the managerial tradition, and that the concept is often opposed by writers in the class and pluralist traditions. This implies that the power and scope of the concept, although having grown greatly in recent years, is inherently limited by its ideological character.

Sunderlin, W.D. 1999. **Between danger and opportunity: Indonesia and forests in an era of economic crisis and political change**. *Society and Natural Resources* **12**(6): 559-570. Policies aiming to improve the conservation and management of tropical forests are often based on the assumption of political and economic stability. Yet some of the most important changes in conditions affecting tropical forests can occur when the political and economic climate changes in an abrupt, unpredicted, and largely uncontrolled manner. This fact is illustrated through preliminary, largely media-based documentation of changes underway in Indonesia. It is unclear, as yet, whether the effects of the sudden transformations on the forest sector in this country will be largely positive or negative.

Sunderlin, W.D. and Resosudarmo, I.A.P. 1999. **The Effect of population and migration on forest cover in Indonesia**. *Journal of Environment and Development* **8**(2): 152-169. The massive loss of quantity and quality of natural forest cover in Indonesia threatens an important source of foreign exchange and employment. Several studies and government policies indicate that population growth, particularly among small landholders, is the principal cause of deforestation. Although there is an element of truth to these studies and policies, they greatly oversimplify and distort the issue of Indonesian deforestation. This article evaluates "population-centered" (neo-Malthusian) explanations of forest cover change in Indonesia in the light of non-population-centered (non-Malthusian) evidence. The conclusion is that although population growth is an important part of of the explanantion of Indonesian deforestation, it should be seen as an i ntermediate variable, and not as an independent variable. The policy implication is that nonpopulation factors should receive greater attention in policy measures directed at controlling inappropriate deforestation.

Sunderlin, W.D. and Wunder, S. 2000. **The influence of mineral exports on the variability of tropical deforestation**. *Environment and Development Economics* **5**: 309-332. Previous studies of deforestation have focused on agriculture, population and migration, timber exploitation, macroeconomic policies and geographic factors to explain the variability of deforestation rates among countries. This study tests the hypothesis that countries with a high proportion of petroleum or non-petroleum mineral exports in total exports experience a relatively low deforestation rate because of macroeconomic 'Dutch disease' effects. Bivariate and multivariate analyses provide preliminary support for the hypothesis, although giving little insight on how precisely mineral exports might exert their influence on forest cover. One reason for the limited utility of these methodologies is that they do not adequately explain the various effects of mineral windfalls that go beyond the Dutch disease's 'core model'. Future research must attempt to understand these effects, which include: levels of funding for agriculture, roads, and directed settlement; agricultural protectionism; levels of rural poverty, urbanisation, and consumer demand; the site-level effects of mineral extraction; and the variability of state autonomy.

Sunderlin, W.D., Angelsen, A. and Wunder, S. 2003. **Forests and poverty alleviation**. In: *State of the world's forests 2003*. FAO, Rome, 61-73 pp. At the beginning of the twenty-first century, poverty remains a problem of huge proportions, with 1.2 billion people, mostly in developing countries, living on less than US$1 a day. Forests can be vital safety nets, helping rural people to avoid, mitigate or rise out of poverty. This function is unknown to many policy-makers and planners because it is not well understood or explained. One reason is that the contribution of forests to poor households is largely unrecorded in national statistics, as most of it is for subsistence or for trade on local markets. In addition, most wealth from timber goes to better-off segments of society, while some aspects of the access to and processing of timber resources actually inhibit their potential to assist marginalized people. Despite these obstacles, the contribution of forests to poverty alleviation can be increased, provided that decision-makers recognize and act on this potential. This chapter specifies two types of poverty alleviation associated with forest resources, as seen at the household level. These are: (i). poverty avoidance or mitigation, in which forest resources serve as a safety net or fill gaps, for example by providing a source of petty cash; (ii) poverty elimination, in which forest resources help to lift the household out of poverty by functioning as a source of savings, investment, accumulation, asset building and permanent increases in income and welfare. There are three main ways of achieving forest-based poverty alleviation: preventing forest resources from shrinking if they are necessary for maintaining well-being (“protecting

the pie"); making forests accessible and redistributing resources and rents ("dividing the pie differently"); and increasing the value of forest production ("enlarging the pie"). All are vital, but they are applied differently, depending on forest use and the strategies adopted.

Tacconi, L. 2003. ***Fires in Indonesia: causes, costs and policy implications***. CIFOR Occasional Paper No. 38, Center for International Forestry Research (CIFOR), Bogor, Jakarta, Indonesia, 24 pp. This paper reassesses the economic costs of 1997-98 fires during the El Niño Southern Oscillation event, defines the fire-related policy problems such as smoke haze pollution and carbon emission, forest degradation and deforestation and loss of products and services, and rural sector losses, and identifies broad policies that may be needed to address the negative impacts of fires in Indonesia.

Turnbull, J. W. 1999. **Eucalypt plantations**. *New Forests* **17** (1-3): 37-52. This paper reviews the historical development of the use of the eucalypt over 200 years, from its curiosity status in the botanical gardens of Europe to its extensive use as a fuelwood for the wood-burning locomotives of the national railway systems, and then to its more recent use as a major source of biomass for paper pulp, fiberboard, industrial charcoal, and fuelwood. Ecological and biological aspects of the genus Eucalyptus have made it successful as an exotic in industrial monocultures and as a multipurpose tree of benefit to small landholders. Social, policy, and economic aspects of growing Eucalyptus are examined, as are prospects for using the eucalypt in the twenty-first century as an industrial plantation tree and as a component of farming systems in the rural landscape.

Van Nieuwstadt, M. G. L., Sheil, D. and Kartawinata, K. 2001. **The ecological consequences of logging in the burned forests of East Kalimantan, Indonesia**. *Conservation Biology* **15** (4): 1183-1186. In 1997-1998 over 50,000 km^2 of East Kalimantan burned, affecting some 23,000 km^2 of natural forest concessions. This is nearly one-quarter (24%) of the area of all natural forest concessions in the province The biomass of the trees living at the time of the burn was little reduced by the fire, which tended to be restricted to the litter and understory, and although many trees died, most stems remained standing. These dead stems in the burned forest represent a significant timber resource. A government regulation was issued indicating that in concessions where fires had occurred, "salvage felling"—harvesting of the remnant commercial dead timber by conventional methods—should precede any continuation of regular harvesting operations in unburned forest areas. The reason for this regulation was that the dead stems could still provide valuable timber if removed before serious deterioration occurred. It was apparently assumed that such salvage activities would have little additional effect on the already degraded forest. There are good reasons, however, to be concerned about the ecological effects of salvage felling after fire. Fire does not in itself cause complete loss of forest cover. The survival and sprouting capacity of primary-forest trees and the seedling establishment of pioneer trees and shrubs suppress the establishment of nonforest species. But, post-fire vegetation is certainly less resilient than might be assumed by anyone witnessing the vigorous post-fire regrowth. The post-fire undergrowth cannot withstand repeated disturbance: previously sprouted individuals show reduced sprouting potential and survival after being damaged a second time, the seedbank is largely reduced after the initial post-fire burst of germination, and the density of vital seed trees is low. The open areas created in the understory by the conventional heavy logging machinery used for salvage felling encourage the rapid development of nonforest vegetation and seriously reduce the potential for recovery. The genuine regenerative potential of burned tropical rainforest and the potential consequences of further disturbance caused by salvage felling need to be

recognized. Our evidence implies that the maintenance of a productive permanent forest estate is likely to be served best by avoiding logging activities in burned areas. Further studies should be made in areas already harvested to further clarify the effects of salvage felling, but until such information is available, caution is the only environmentally defensible option. Authors note that they have presented only ecological concerns, but there are other reasons to review current practices of salvage harvesting. In Indonesia, concession holders cannot normally recut harvested forest areas without waiting the statutory period (a 20-year cutting cycle is the norm). If fire occurs in a concession, however, this restriction is lifted and further cutting is allowed. Such incentives must be avoided.

van Soest, D.P., Bulte, E.H., Angelsen, A. and van Kooten, G.C. 2002. **Technological change and tropical deforestation:** a perspective at the household level. *Environment and Development Economics* **7**(2): 269-280. This paper analysis the effects of technological change in agriculture on forest clearing by households in developing countries. The possible effects are found to be many and diverse, depending on the type of change and the institutional context. It concludes that agricultural intensification is certainly not the panacea that some believe it to be.

Vanclay, J. K. and Skovsgaard, J. P. 1997. **Evaluating forest growth models**. *Ecological Modelling* **98**(1): 1-12. Effective model evaluation is not a single, simple procedure, but comprises several interrelated steps that cannot be separated from each other or from the purpose and process of model construction. Authors draw attention to several statistical and graphical procedures that may assist in model calibration and evaluation, with special emphasis on those useful in forest growth modelling. Authors propose a five-step framework to examine logic and bio-logic, statistical properties, characteristics of errors, residuals, and sensitivity analyses. Empirical evaluations may be made with data used in fitting the model, and with additional data not previously used. Authors emphasize that the validity of conclusions drawn from all these assessments depends on the validity of assumptions underlying both the model and the evaluation. These principles should be kept in mind throughout model construction and evaluation.

Vanclay, J. K., Gillison, A. N. and Keenan, R. J. 1997. **Using plant functional attributes to quantify site productivity and growth patterns in mixed forests**. *Forest Ecology and Management* **94**(1-3): 149-163. Forest growth models form one of several important prerequisites for sustainable management. The complexity of tropical moist forest means that there is often little objective information to classify sites and species for growth modelling and yield prediction. Classification based on observable morphological characteristics may be a useful surrogate for, or supplement to, other alternatives. This study investigated the utility of plant functional attributes (PFAs) for site and species classification. PFAs describe a plant in terms of its photosynthetic and vascular support system, and the sum of individual PFAs for all species on a plot provides an efficient summary of vegetation features at the site. Preliminary observations suggested that the PFA summary may also indicate site productivity, and that specific PFAs may be used to group species for modelling growth and yield. Data from 17 permanent plots in the tropical rainforests of North Queensland were used to test these preliminary observations. Standard PFA proformas were completed for each plot in January 1995, and the relationships between the PFAs, site productivity and specific growth patterns were examined using discriminant analysis, linear regression and standard statistical tests. Results indicate that mean leaf size, and the incidence of species with vertical leaf inclination (more than 30° above horizontal) are significantly correlated

with site productivity. Of the PFAs assessed, five elements appear to offer a useful basis for grouping species for modelling: leaf size and inclination, a furcation index (i.e. relative height to first fork or break in the main stem), and the presence of lenticels and chlorophyllous tissue on the main stem. The restricted nature of our database limits comment on the general utility of the method, but results suggest that further work on PFAs is warranted.

Vanclay, J.K. 1995. **Growth models for tropical forests:** a synthesis of models and methods. *Forest Science* **41**(1): 7-42.

Vanclay, J.K. 1996. **Assessing the sustainability of timber harvests from natural forests: limitations of indices based on successive harvests**. *Journal of Sustainable Forestry* **3**(4): 47-58.

Vanclay, J.K. 1999. **On the nature of keystone species**. *Conservation Ecology* **3**(1): r3 [on line] URL: http://www.ecologyandsociety.org/vol3/iss1/resp3/index.html

Wadley, R. L. and Colfer, C. J. P. 2004. **Sacred forest, hunting, and conservation in West Kalimantan, Indonesia**. *Human Ecology* **32**(3): 313-338. In a number of places, sacred forest sites play an important role in conservation and local livelihoods. This paper examines how Iban hunters and animals alike use sacred forest in West Kalimantan, Indonesia. To determine the relative importance of different sites in hunting, it compares hunting effort, animal species and their numbers encountered by hunters, and encounters and captures in a variety of forest sites including sacred groves. The authors relate the results to the role of such sites in the overall Iban agroforestry system and in the conservation of forest habitat that professional conservationists deem precious. Such land use practices, while having social and religious origins, may be important for local economic purposes, but they may also be valuable in promoting and enhancing the more global goals of biodiversity conservation.

Wadley, R. L., Colfer, C. J. P., Hood, I. G. 1997. **Hunting primates and managing forests: The case of Iban forest farmers in Indonesian Borneo**. *Human Ecology* **25** (2): 243-271. Hunting by Iban forest farmers in West Kalimantan, Indonesia, is an important part of their subsistence economy, and as such became a focus of study as part of a conservation project in the Danau Sentarum Wildlife Reserve. In this paper, authors examine Iban hunting of nonhuman primates with comparison to other large mammals. Authors analyze rates of encounter and capture, comparing encounters, hunting trips, and animal numbers. Information on habitats hunted shows the importance of secondary and old growth forest. Also examined are Iban attitudes, game preferences, and taboos. The significance of these findings is discussed with regard to the threats to wildlife from increases in the use of shotguns, human population, and habitat destruction, showing that conservation may be aided by promoting or enhancing certain aspects of the traditional Iban agroforestry system.

Wadley, R.L. 2002. **Coping with crisis - smoke, drought, flood and currency: Iban women and their households in West Kalimantan**. *Culture and Agriculture* **24**(1): 26-33. In recent years, rural households throughout Indonesia have faced a variety of crises, including severe drought, smoke from forest fires, and floods - all of which have affected subsistence farming. Simultaneous with these problems has been the wider Asian economic crisis that destabilized Indonesia both economically and politically. For rural people, it has affected cash-earning opportunities and prices of basic goods. Focusing on the Iban of West Kalimantan, this paper explores the impacts these various crises have had on Iban farming

and wage labor, and how the Iban have coped. It touches on the successful strategies from the past as well as recent local developments that have appeared to cushion the continuing economic uncertainty. This paper contributes to the growing literature on the impact of climatic fluctuation and economic change on the livelihoods of local people in Southeast Asia and other parts of the Third World.

Wang Qinghua. 2001. **Forest management and terraced agriculture**: **case study of Hani of Ailao mountains, Yunnan**. *Economic and Political Weekly* **36**(30): 2846-2850. This case study of the Hani in the Ailao mountains of Yunnan, China, highlights the importance of forests in providing local ecological services that are essential for the system of terraced agriculture. The paper investigates local people's knowledge of these ecological services, including water regulation and nutrient recycling, as well as the gender differences in the local knowledge of these services. The paper notes that the Hani have maintained the forest condition quite irrespective of its tenurial status. Contemporary forest policies and reforestation in the area are also discussed.

Wollenberg, E. K. 2001. **Incentives for collecting gaharu (fungal-infected wood of *Aquilaria* spp.; Thymelaeaceae) in East Kalimantan**. *Economic Botany* **55**(3): 444-456. The economic importance of gaharu is assessed in three villages on the Bahau River in north-central Borneo to gain insights about the incentives for harvesting and management of a valuable nontimber forest product (NTFP). Three indicators of economic value (level and proportion of income, returns to labour, and proportion of gaharu collecting households per village) are used to demonstrate the multiple incentives that NTFP income can generate. The concept of incentive logic is developed as an analytical technique to show how economic values can be linked to incentives for different types of management actions. The article discusses how incentives from gaharu income were most likely linked to the stake local people had in the resource, their preferences about which forest product to harvest, and their willingness to engage in collective action. These incentives contributed to sustainability to the extent they induced actions that reduce threats to the resource. The article suggests that an understanding of the influence of economic incentives on people's resource management can be improved by recognizing three factors: the multiple incentives created by an income; the logical link of those incentives to a management action; and the influence of other sociocultural and biophysical factors on management.

Wollenberg, E., Anderson, J. and Edmunds, D. 2001. **Pluralism and the less powerful: accommodating multiple interests in local forest management**. *International Journal of Agricultural Resources, Governance and Ecology* **1**(3/4): 199-222. Forest decision making is becoming more pluralistic. As the numbers of groups involved in forest decisions have increased, concern about how to accommodate multiple interests has similarly burgeoned. In this article, authors present pluralism as a foundation for understanding how less powerful group's interests can be accommodated. Authors examine approaches to how interests are defined, communicated and coordinated to review the scope of possibilities for improving pluralism. Experience with these methods suggests that accommodation that genuinely reflects the interests of disadvantaged groups is most likely to occur where state and civil society governance institutions provide opportunities for: (1) mutual learning among interest groups; (2) iterative cycles of bounded conflict and co-operation; (3) public, transparent decision making; (4) checks and balances in decision making among groups; and (5) the provision of capacity building or political alliances for disadvantaged interest groups. High transaction costs, persistent injustices and impossibility of neutral facilitation pose

contradictions to the possibilities of achieving accommodation and need to be recognized and negotiated.

Wollenberg, E., Edmunds, D. and Buck, L. 2000. **Using scenarios to make decisions about the future: anticipatory learning for the adaptive co-management of community forests**. *Landscape and Urban Planning* **47**(1-2): 65-77. Current trends to improve the adaptiveness of community forest management focus on monitoring past actions and emphasize internal dynamics. Authors show how scenario methods can be used to (1) enable managers to better understand landscape and larger scale forces for change and to work with stakeholders at these levels and (2) improve adaptiveness not only by responding to changes, but also by anticipating them. Authors review methods related to scenario analysis and discuss how they can be adapted to community management settings to improve the responsiveness and the collaboration among stakeholders. The review is used to identify the key elements of scenario methods that CIFOR will test among communities in Bulungan Regency, East Kalimantan, Indonesia and two villages in the buffer zone of Ranomafana National Park, Madagascar.

Wollenberg, E., Iwan, R., Limberg, G., Moeliono, M., Rhee, S. and Sudana, M. 2004. **Muddling towards cooperation: a CIFOR case study of shared learning in Malinau District, Indonesia**. *Currents* **33**: 20-24.

Woollenberg, E., Edmunds, D., Buck, L., Fox, J., Brodt, S. (eds.) 2001. ***Social learning in community forests***. Center for International Forestry Research, Jakarta, Indonesia 209 pp. This book contains 10 papers on innovative approaches to forest management that encourage social learning among multiple stakeholders.

Wunder, S. 2000. **Ecotourism and economic incentives: an empirical approach**. *Ecological Economics* **32**(3): 465-480. Within the new array of 'green' products and services, ecotourism claims to combine environmental responsibility with the generation of local economic benefits that will have both a development impact and serve as conservation incentives. Economic incentives are imperative for nature conservation, particularly in remote and ill-monitored regions where a weak state presence hinders the use of alternative tools of environmental regulation. In the following, the link between tourism, local benefits and conservation is conceptualised and analysed empirically, using data from the Cuyabeno Wildlife Reserve in the Ecuadorian Amazon region, near the border of Colombia and Peru. Three Cuyabeno indigenous groups have developed different modes of tourism participation, ranging from autonomous operations to pure salary employment. A quantification of local cash flows from tourism allows for a comparative analysis of income structure, spending, and the impacts on local development and on conservation attitudes. It is concluded that in the whole study area, tourism has actually provided significant additional income. Counter to common belief, the mode of participation is less decisive for local income generation than the tourist attraction of the natural site, the degree of tourism specialisation and the level of local organisation. However, as a conservation incentive, the effectiveness of tourism income depends on the incentive structure inherent in the mode participation, and on the substitution versus complementary of other productive activities: only if tourism changes labour and land allocation decisions, will it have a local conservation impact. It is discussed under which circumstances the conjectured link between tourism, local incomes and conservation is likely to be effective. This leads to some general lessons for government policies, for the design of integrated conservation and development projects, and to a number of site-specific recommendations for improving ince...(truncated).

Wunder, S. 2001. **Poverty alleviation and tropical forests—What scope for synergies**? *World Development* **29**(11): 1817-1833. This paper explores the "state-of-the-art" of the two-way causal links between poverty alleviation and natural tropical forests. Microimpacts of rising poverty can increase or slow forest loss. At the macrolevel, poverty also has an ambiguous effect, but it is probable that higher income stimulates forest loss by raising demand for agricultural land. The second question is what potential forest-led development has to alleviate a country's poverty, in terms of producer benefits, consumer benefits and economy-wide employment. Natural forests widely serve as "safety nets" for the rural poor, but it proves difficult to raise producer benefits significantly. Urban consumer benefits from forest, an important target for pro-poor agricultural innovation, are limited and seldom favor the poor. Absorption of (poor) unskilled labor is low in forestry, which tends to be capital-intensive. Natural forests may thus lack comparative advantage for poverty alleviation. There are few "win–win" synergies between natural forests and national poverty reduction, which may help to explain why the loss of tropical forests is ongoing. This may have important implications for our understanding of "sustainable forest development" and for the design of both conservation and poverty-alleviation strategies.

Wunder, S. 2003. **Native tourism, natural forests and local incomes on Ilha Grande, Brazil**. In: Gössling, S. (ed.) *Tourism and development in tropical islands: political ecology perspectives*. Edward Elgar Publishing Ltd, Cheltenham, UK, 148-177 pp. The first sections of this chapter discuss the land-use history of Ilha Grande, Brazil, as well as the characteristics of domestic forest-based tourism in the area. Some contradictory interests of local tourism stakeholders (guesthouse owners and up-market tourists, camping ground owners and backpackers, the municipality, and land speculators) are then discussed. Finally, the socioeconomic impacts of tourism on the island's local population are quantified, using the example of Aventureiro village. The chapter challenges the dominant view that the tourism 'carrying capacity' of the island has been surpassed and that low-spenders' access should be restricted to prevent a downward spiral of social, environmental and economic degradation. It shows that there is no evidence to back up claims of lasting physical degradation of the island's environment or social deprivation of its residents. Looking specifically at the case of Aventureiro, it is revealed that low-income tourism in the village generates sizeable incomes: annual tourism income per family is over US$10000, and per-capita income is over US$2000.

Wunder, S. 2003. ***Oil wealth and the fate of forest: a comparative study of eight tropical countries***. London, Routledge. xxi, 432p. Oil production can damage rainforests, but this is just one side of a complicated story about the impact of oil on land use. This book a study of eight tropical oil-producing countries, examines the linkages between trade, macroeconomics and policies affecting the environment. In a balanced and comprehensive review, including a detailed assessment of land use in Cameroon, Ecuador, Gabon, Papua New Guinea and Venezuela, the author comes up with a counterintuitive suggestion: oil revenues often indirectly come to protect tropical forests. There are numerous implications for policy formulation to decide what can be done to diminish deforestation without jeopardising economic growth.

Wunder, S. 2003. ***Oil wealth and the fate of the forest: a comparative study of eight tropical countries***. Routledge, London, 432 pp. This book consist of 10 chapters and examines the linkages between trade, macroeconomics and policies affecting the environment. The first chapter presents an overview of the economic theory of oil wealth and the Dutch Disease - its

origins, core model, theoretical extensions and application to both developed and developing countries. Chapter 2 links the Dutch Disease to land use and forests, formulates the key hypotheses and explains the basic comparative methodology used for the country case studies. Chapter 3 explains the basic definitions and methods used for key forest output variables, deforestation and forest degradation. Chapters 4-8 looks closely at the situations in each of the 5 primary case-countries (Gabon, Venezuela, Cameroon, Ecuador and Papua New Guinea) using the comparative methodology developed in the second chapter including the historical overviews of shifts over time in oil wealth, policies, land use and forest conditions. Chapter 9 then broadens the perspective to the 3 secondary, large-country cases: Mexico, Nigeria and Indonesia. Finally, in the chapter 10, both primary and secondary cases are compared from which the key hypotheses are revisited, and the different forest outcomes are discussed in terms of country-specific preconditions versus variable domestic policy responses.

Yasmi, Y. 2003. **Understanding conflict in the co-management of forests: the case of Bulungan Research Forest**. *International Forestry Review* **5**(1): 38-44. The paper describes underlying causes of conflicts between local people in Bulungan Research Forest in Indonesia with coal-mining and logging companies. Results show that conflict between local people and mining companies was triggered by the fact that the mining operation caused water and air pollution and soil degradation. Another cause for the conflict was the compensatory facilities (e.g. clean water, electricity, compensation fee, etc.) provided by the companies to local people that were often delayed or unsatisfactory. Local people perceived that their major problem with logging activities was the adverse impact to residual plants such as rattan, eagle wood, medical plants, etc. Not only that, logging companies did not allow local people to cut trees for their own uses such as for houses or churches. The paper concludes that there is a need for negotiation among those parties involved in conflict in such a way that negative impacts can be reduced and positive impacts can be enhanced.

Yeo-Chang Youn. 2004. **The production of oak mushroom (*Lentinua edodes*) as a source of farmer's income in the Republic of Korea: the case of Cheongyang-Gun**. In: Kusters, K. and Belcher, B. (eds.) *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Product Systems, Vol. 1. Asia*, Center for International forestry Research (CIFOR), Indonesia, 95-105 pp. There were 6888 households cultivating oak mushroom in South Korea. In the 2000, the average production was 686 kg per mushroom grower. In Cheongyang-Gun there are 398 mushroom growing households. Their average annual household income was 20% higher than the average income of a farmer in the study area.

Ying Long Chen. 2004. **Song rong (*Tricholoma matsutake*), a valuable forest mushroom from China: consumption, development and sustainability**. In: Kusters, K. and Belcher, B. (eds.) *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Product Systems, Vol. 1. Asia*, Center for International forestry Research (CIFOR), Indonesia, 79-94 pp. Song rong (*Tricholoma matsutake*) is the most valuable mushroom of the region. The case study in Zixi mountain area of Yunnan province, China suggests that in this are 62% of annual cash income of people may come from the mushroom. The average annual household income in four villages in 1998 was US$714.3. In the same year 62% (6793 persons) of the people were involved in the commercial mushroom extraction. The average annual income of these producer households was US$917.6. It is also noteworthy that for an average producer household US$571.4 came from mushroom production and US$107.1 from

agriculture, poultry and tobacco growing. In this area local labour rate ranges between US$1.8 and 3.6 per day.

Young, A., Boyle, T. and Brown, T. 1996. **The population genetic consequences of habitat fragmentation for plants**. *Trends in Ecology & Evolution* **11**(10): 413-418. Habitat fragmentation reduces the size and increases the spatial isolation of plant populations. Initial predictions have been that such changes will be accompanied by an erosion of genetic variation and increased interpopulation genetic divergence due to increased random genetic drift, elevated inbreeding and reduced gene flow. Results of recent empirical studies suggest that while genetic variation may decrease with reduced remnant population size, not all fragmentation events lead to genetic losses and different types of genetic variation (e.g. allozyme and quantitative variation) may respond differently. In some circumstances, fragmentation actually appears to increase gene flow among remnant populations, breaking down local genetic structure.

Zuidema, P.A., Sayer, J.A. and Dijkman, W. 1996. **Forest fragmentation and biodiversity: the case for intermediate-sized conservation areas**. *Environmental Conservation* **23**(4): 290 - 297. Understanding the effects of forest fragmentation on biodiversity is essential for successful and efficient forest conservation. Four factors may cause loss of biodiversity in forest fragments: the effect of non-random sampling of the original forest, reduced forest size, isolation and edge effects. A review of 58 papers on effects of forest fragmentation reveals that general conclusions from fragmentation research are biased due to a focus on birds, on size-effects rather than isolation, and on species presence rather than population sizes. Perhaps the most important finding is that current knowledge on fragmentation effects is based mainly on studies in small fragments (<10 ha). These are dominated by edge effects, can not contain viable populations for many species and are rarely the focus of conservation programmes. Studies of small fragments can not be extrapolated to larger-sized, protected areas. Conservation of medium-sized, strategically-located areas may be a more efficient option for biodiversity conservation, given financial, social and logistic limitations. More research is needed on forest management that are representative of the sizes of real-world protected areas (i.e.>10 000 - 100 000 ha) and should focus on the biological and human-induced processes which determine species persistence.

Center for International Forestry Research (CIFOR)

The Center for International Forestry Research (CIFOR) was established in 1993 as part of the Consultative Group on International Agricultural Research (CGIAR) in response to global concerns about the social, environmental and economic consequences of forest loss and degradation. CIFOR research produces knowledge and methods needed to improve the well-being of forest-dependent people and to help tropical countries manage their forests wisely for sustained benefits. Since it was founded, CIFOR has also played a central role in influencing global and national forestry policies.

CIFOR is an international research and global knowledge institution committed to conserving forests and improving the livelihoods of people in the tropics. CIFOR's high impact research helps local communities and small farmers gain their rightful share of forest resources, while increasing the production and value of forest products. CIFOR employs over 150 staff at its headquarters in Bogor, Indonesia and at its regional offices in Brazil, Cameroon, Zimbabwe, Burkina Faso and India. It works in over 30 countries worldwide and has links with more than 300 researchers in 50 international, regional and national organisations. Governed by an international board of trustees with 15 members from 12 countries, CIFOR receives contributions from over 50 governments and funding agencies.

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