Forest and Agroecosystem Tradeoffs in the Humid Tropics

Alternatives to Slash-and-Burn Programme
Millennium Ecosystem Assessment Status Report
covering completion of ASB-MA Pilot Phase (2003)
and incorporating ongoing assessment activities (2004-5)

Forest and Agroecosystem Tradeoffs in the Humid Tropics

A Crosscutting Assessment by the Alternatives to Slash-and-Burn Consortium (ASB)
conducted as a Sub-Global Component of the Millennium Ecosystem Assessment

ASB-MA short title: Tropical Forest Margins

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Acronyms and Abbreviations

AgEE	Agriculture Ecosystems and the Environment
AMUCAU	Asociación de Mujeres Campesinas de Ucayali (Ucayali Peasant Women's Association)
ASB	Alternatives to Slash-and-Burn System-wide Programme
BNPP	World Bank Netherlands Partnership Programme
C	Carbon
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical (International Centre for Tropical Agriculture)
CIFOR	Center for International Forestry Research
Embrapa	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Enterprise for Agricultural and Livestock Research)
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse Gas
GSG	Global Steering Group
ha	hectare
ICRAF	International Centre for Research in Agroforestry (World Agroforestry Centre)
IFPRI	International Food Policy Research Institute
INBAR	International Network for Bamboo and Rattan
INIA	Instituto Nacional de Investigación Agraria (National Institiute for Agricultural Research)
INRM	Integrated Natural Resource Management
ITTO	International Tropical Timber Organization
LUCC	Land Use and Land Cover Change
MA	Millennium Ecosystem Assessment
NARS	National Agricultural Research Systems
NGO	Non-governmental Organization
PAM	Policy Analysis Matrix
PB	Policybrief
PFTs	Plant Functional Types
t	tons
TVE	Television Trust for the Environment
UNH	University of New Hampshire
UoW	University of Washington
USAID	United States Agency for International Development
WHO	World Health Organization
WWF	World Wildlife Fund

Summary

ASB's assessment, 'Forest and Agroecosystem Tradeoffs in the Humid Tropics' (known as 'Tropical Forest Margins'), is the only crosscutting sub-global assessment approved by the Millennium Ecosystem Assessment (MA). Focusing on ecoregions nested within the humid tropical broadleaf forest biome, the aim is to conduct an assessment covering the ecoregions containing ASB benchmark sites in the Peruvian Amazon, the western Amazon of Brazil, an associated site in the eastern Amazon of Brazil, the Congo Basin of Cameroon, northern Thailand, and the islands of Sumatra in Indonesia and Mindanao in the Philippines. This 'Tropical Forest Margins' assessment will synthesize estimates of various indicators of environmental and developmental objectives for ASB benchmark sites spanning the humid tropics, and will endeavor to place these results within the broader context of relevant scientific evidence. These indicators have been used successfully to assess the degree of tradeoffs (and complementarities) between global environmental objectives (served by rainforest conservation) and national and local objectives (often involving conversion of natural forest to other uses), and also to assess the scope for policy to effectively, efficiently, and equitably manage these tradeoffs.

ASB brings to the MA proven methods and existing data bases for plot-level indicators, on-going development of methods for landscape and watershed scale assessment, a pantropic analysis of the nexus among tropical hydrology, biodiversity, and poverty that is nearing completion, strong institutional links and long-term presence at benchmark sites in the humid tropics, experience in capacity building, and an established track record in multi-disciplinary, multi-institutional, and multi-scale collaboration on integrated natural resource management.

ASB results show that striking an equitable balance between the legitimate interests of development and equally legitimate global concerns over the environmental consequences of tropical deforestation is difficult. Poverty reduction in most of the tropics depends on finding ways to raise productivity of labor and land through intensification of smallholder production systems. Although there may be opportunities to alleviate poverty while conserving tropical rainforests, it is naïve to expect that productivity increases necessarily slow forest conversion or improves the environment. Deforestation has no single cause but is the outcome of a complex web of factors whose mix varies greatly in time and space. Understanding the factors at work in a given situation is a crucial first step if policymakers are to introduce effective measures to curb deforestation, and to do so in ways that reduce poverty.

A series of stakeholder consultations to identify user needs provide the basis for development of the questions that will guide assessment teams for specific topics. Outputs planned later in 2006 and through 2007 are structured around these policy-relevant questions. The plan is to organize each team to produce one (or more) ASB Policybriefs on their topic as intermediate outputs that later will be combined into a comprehensive assessment product.

Part I. Overview

1.1. Status of ASB-MA

1.1.1. ASB-MA pilot phase in 2003

Noteworthy achievements and activities during the ASB-MA pilot phase in 2003 include a successful inception meeting in March 2003; launch of important new initiatives in strategic stakeholder analysis and process documentation; completion at yearend of a nested, pantropic assessment of the nexus of tropical hydrology, biological diversity, and human population; completion of a major book, *Slash and Burn: The Search for Alternatives* (2005), which synthesizes the first decade of research by the ASB program and provides a peer-reviewed base for the ASB-MA assessment, particularly at the plot scale (see Annex 1); completion of a special issue for the journal *Agriculture Ecosystems and Environment* (2004), entitled *Environmental Services and Land Use Change*, which provides a peer-reviewed base for extension of the ASB-MA assessment to topics at the landscape scale, including smoke pollution, biodiversity functions, and watershed functions (see Annex 2); active participation by several ASB scientists in the MA Sub-global Working Group; scenarios training opportunities for two young ASB researchers (a Peruvian and a Cameroonian); stronger efforts in data management and public access; and continued output of communication products, including a website, ASB *Policybriefs*, and ASB-MA posters.

1.1.2. Update on ASB-MA assessment activities in 2004 and 2005

This status report has been revised to reflect the internal review of a previous draft, and updated to include activities completed and ongoing in 2004. Building on an earlier process-oriented study of ASB's impact channels (Liu, 2003), an on-line consultation among ASB scientists was held to document areas of consensus and divergence about key ASB organizational processes (see Tomich et al., 2004, 2006), which are relevant to the MA and multi-level assessments more generally. The consultation concluded in January 2004 and the results were presented at the MA workshop on Bridging Scales and Epistemologies in Alexandria, Egypt, in March 2004. Additional process-oriented issues are being addressed in a strategic stakeholder analysis conducted in conjunction with user needs assessments. A report of that stakeholder analysis is expected by the end of 2004.

Local and national consultations for user needs assessments were completed for Indonesia, Cameroon, and Peru by June 2004. Together with work on MA user needs in Thailand and Brazil in 2003, these assessment questions from specific ASB benchmark sites and participating countries have been synthesized by the coordinating lead authors to produce a set of questions to guide assessment teams (see Annex 7).

Building on the synthesis of users' needs, a protocol for the ASB-MA ecosystem goods (provisioning services) assessment was developed in June 2004 (see Annex 8). Based on these procedures, data on

ecosystem goods were compiled at ASB benchmark sites and for larger administrative units during August and September 2004. Partners from all ASB benchmark sites gathered in Nairobi, Kenya, from 4-7 October 2004 for a workshop entitled "Scaling Up the Goods Assessment" to develop plans and a written protocol for "scaling up" the goods analyses from benchmark sites to states/provinces and other larger units. Post workshop tasks (from October 2004 to early 2005) included collaboration in analysis and assessment of major goods produced at the tropical forest margins within ASB ecoregions, development of spatial indicators for goods produced, and trend analyses of land use, production and yield as indicators of ecosystem condition and trends in sustainability (see Annex 11).

Training in formulation and use of scenarios was identified as a top priority for capacity building during the ASB-MA inception meeting in 2003. Thanks to funding from the Government of Netherlands and close collaboration with members of the MA Scenarios technical support team, a training workshop was conducted in November 2004 in Chiang Mai, Thailand, to train ASB facilitators from all ASB sites in participatory formulation and use of scenarios. Follow up to the workshop included local and national scenarios activities at ASB sites in 2005 and a 'virtual' on-line event to compare results and distill lessons learned in 2006.

In conjunction with ASB-MA activities, a consultant has prepared a comprehensive set of recommendations regarding implementation of a new ASB data policy in order to achieve the objectives of thorough documentation and public availability of ASB datasets. These recommendations were approved by the ASB Global Steering Group during its meeting in December 2004.

The ASB-MA team has collaborated in the production of a video on the Northern Thailand benchmark site by the Television Trust for the Environment (TVE), which could be a prototype for the broader communication strategy for sub-global assessments.

The synthesis of consultations with users mentioned above regarding ecosystem services also produced a number of assessment questions regarding human well-being and responses (Annex 9). The coordinating lead authors hope to host a writing workshop for the ASB-MA team to frame the work on human well-being. Funding is being sought for this important activity. Final decisions on specific assessment questions regarding responses have been deferred to 2006, pending completion of assessment of conditions and trends and scenarios training.

1.1.3. Background on ASB

ASB works at the nexus of two important problems: tropical deforestation, and human poverty. Deforestation is often blamed on the slash-and-burn practices of migrant smallholders, millions of whom do clear and cultivate small areas of forest by this method. However, other groups are also involved, including plantation owners, other medium- and large-scale farmers, ranchers, logging groups and state-run enterprises and projects. These groups often clear much larger areas, leading to conflict with traditional users.

ASB was founded in 1994 as a system-wide program of the Consultative Group on International Agricultural Research (CGIAR) and is convened by the Nairobi-based World Agroforestry Centre (ICRAF). ASB is a global partnership of over 50 institutions around the world with a shared interest in two of the greatest challenges confronting the world today: conserving forests, and reducing poverty in the humid tropics. The idea underlying ASB was born in a scientific meeting held in Porto Velho, Brazil, in 1992 with a group of scientists from around the world working in tropical areas.

The basic goal of ASB is *to identify and articulate combinations of policy, institutional and technological options that can raise productivity and income of rural households without increasing deforestation or undermining essential environmental services*. Although there are some opportunities to reduce poverty while conserving tropical forests, tropical deforestation typically involves tradeoffs among the concerns of poor households, national development objectives and the environment.

ASB unites research institutes, NGOs, universities and other local, national and international partners. Its collaborative aims are to:

- identify and test innovations that will help eradicate poverty while simultaneously curbing the environmental problems associated with deforestation;
- provide fora for exchanging information, developing consensus and managing conflicts at the local, national, regional and global levels;
- build capacity of the national ASB consortia to promote equitable and sustainable rural development.

1.1.4. ASB benchmark sites

Sustained collaborative research by ASB partners has facilitated the establishment of benchmark sites in the western Amazon of Brazil and Peru, the Congo Basin forest of Cameroon, the island of Sumatra in Indonesia, the northern mountains of Thailand, and the island of Mindanao in the Philippines (see Figure 1). ASB benchmark sites are areas (roughly 10^2-10^3 km^2) of long-term study and engagement by ASB partners with households, communities and policymakers at various levels. Human population of the specific benchmark sites ranges from 10^4-10^5 and, comparing across sites, densities range from <20 to >170 persons km^{-1}.

Through this network of sites that spans the humid tropics, ASB ensures that its analyses of local and national perspectives are grounded in reality. ASB's thematic working groups (on biodiversity, climate change, agronomic sustainability and sustainable land use mosaics, economic and social indicators, and global synthesis of implications for policy, institutional, and technological options) develop innovative methods as needed and ensure that data are comparable across sites. For more information visit the ASB website at http://www.asb.cgiar.org.

1.2. ASB-MA scope and context

The scope of the ASB-MA assessment of forest and agroecosystem tradeoffs is bounded in the first instance by the tropical and subtropical moist broadleaf forest biome (Olson et al., 2001). The established ASB benchmark sites in the Peruvian Amazon, the western Amazon of Brazil, Cameroon, Thailand, Indonesia, and the Philippines all fall within the tropical portion of that biome. An additional site in the eastern Amazon of Brazil in the state of Para also was added as a result of discussions during the ASB-MA inception meeting in March 2003. The intended scope of the ASB-MA assessment is the specific ecoregions that contain these benchmark sites: http://www.asb.cgiar.org/gallery/asbmasitemap_WWFecoregion.jpg.

Current estimates by ASB indicate that more than 1.8 billion people live within this tropical forest biome; ongoing refinements based on newly released data will likely increase that figure substantially. Most are poor households directly dependent on forest resources and agriculture for their livelihoods. Other poor households suffer indirectly from waste of these resources and environmental degradation. Deforestation is often blamed on the slash-and-burn practices of migrant smallholders, millions of whom do clear and cultivate small areas of forest by this method. However, other groups also are involved, including plantation owners, other medium- and large-scale farmers, ranchers, loggers and state-run enterprises and projects. These groups often clear much larger areas than do smallholders, leading to conflict with smallholders.

1.2.1. Landscape mosaics at tropical forest margins

(contacts: T Tomich, M van Noordwijk, C Palm, K Sebastian, C Legg)

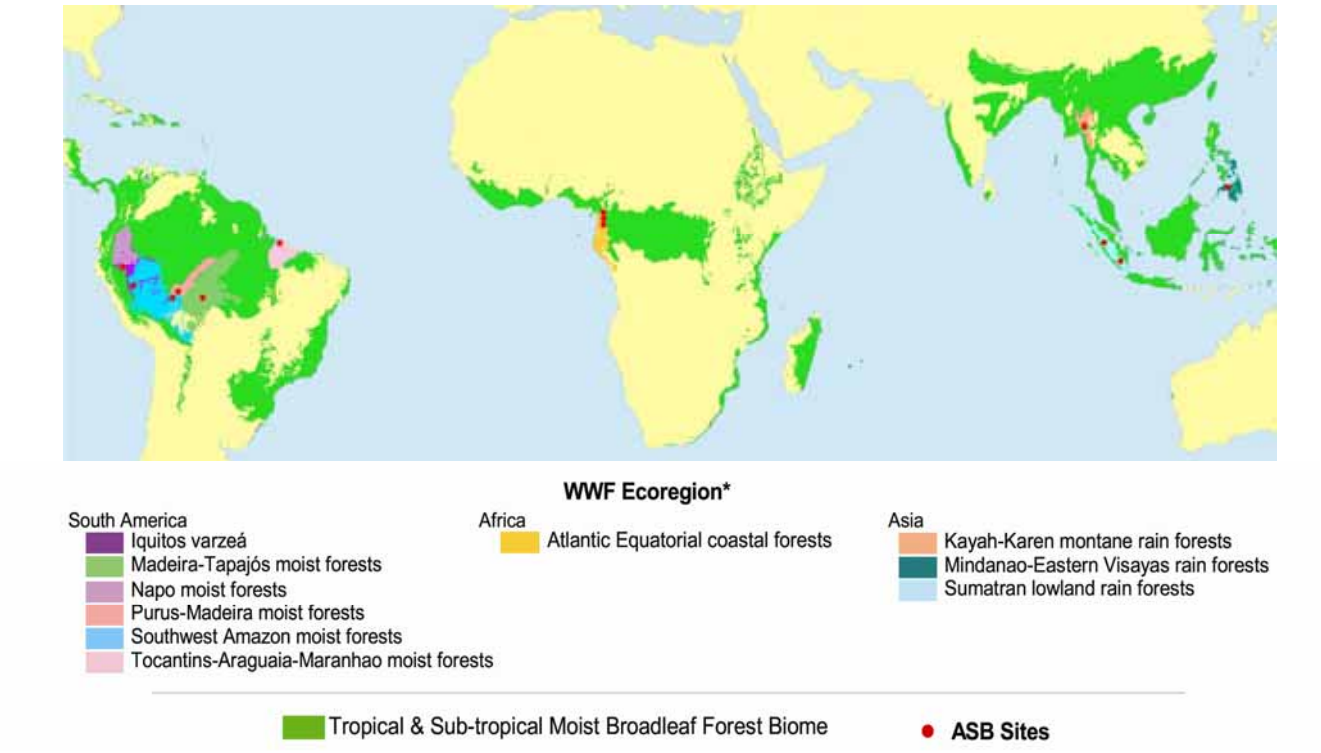
While clearing forests for pasture development is easily recognized through remote sensing, much of the change at the 'forest margin' is more gradual and defies detection by remote sensing techniques. The combined land use systems, with portions of fields, farms and landscapes in agricultural crops/pastures, agroforestry and forests, are classified as agriculture/forest mosaics and are now recognized as quite extensive in area and importance in terms of the maintenance/disruption of ecosystem functions. However, the legends used in studies of land cover change do not in general do justice to the gradients in land use intensity that occur within such mosaics. Along with this comes the realization that we do not understand some of the processes by which these fragmented landscapes function in terms of providing ecosystems services. That has become the focus of current work. A tentative index of land use intensity (I_{LUI}) has been proposed by Meine van Noordwijk to capture the multiple dimensions of 'intensification' into a single metric that will allow comparisons within and across benchmark areas. We expect that this exercise will lead to refinement of the index or the use of more specific indicators for specific questions.

The recognition and classification by the ASB consortium of many of the different tree-based systems that exist on small-scale plots throughout much of the tropics but that were once categorized as forest or agriculture (because of the scale problems) is a source of valuable information that can feed into global

databases. Putting such systems on the map in a literal sense is a first step in gaining recognition for their existence at the policy level, and contributing to negotiations between farmers and local government.

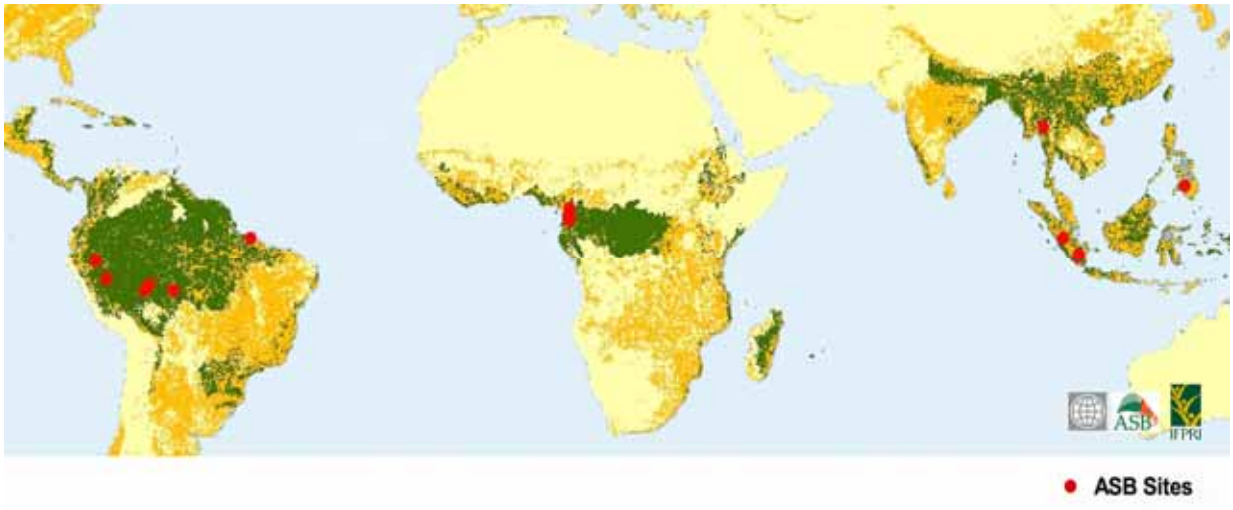
Conversely, new data products at the global scale (some arising from MA activities) make it possible for the first time to begin to portray the importance of these mosaic landscapes. By overlaying new spatial analyses of cropland and pasture extent with tree cover and forest data, ASB-MA colleagues at the International Food Policy Research Institute (IFPRI) have produced a first approximation of the extent of these mosaic landscapes across the moist broadleaf forest biome (see Figure 2) (http://www.asb.cgiar.org/gallery/ASB-MAsites.ppt).

Figure 1. ASB-MA sites



*All of the mapped ecoregions except for the Tocantis-Araguaia-Maranhao moist forests are clasiffied by WWF as Global 200 Ecoregions.

Figure 2. ASB-MA sites in forest/agriculture mosaic areas and the forest biome



1.2.2. Multi-scale approach

(contacts: T Tomich, M van Noordwijk, C Palm)

1.2.2.1 How many scale-levels did you use in the assessment and how many (and which ones) would best inform your assessment? Please specify the "ideal" levels.

Explicit use of nested scales is important for (a) sampling methods for quantitative data collection based on initial typologies and strata and helping to refine them for further work, (b) recognition of the 'scaling rules' for quantitative properties used in the various criteria and indicators, and of the impact of differences between the scaling rules of the various indicators on the perceived tradeoffs, and (c) understanding of 'user needs', linked to these tradeoffs at various scales.

a) The different scales for the assessment cover the global, continental, national, benchmark (or local), watershed, community, farm/household, and plot levels, with initial focus on the local, farm and household levels, and current focus on intermediate scales (watershed) and global relevance. The **global level** consists of the humid tropical broadleaf forests and deforestation fronts of three continents (South America, Africa and Asia). It is at this level that data are ultimately integrated for identification of global trends and differences, and for extrapolation purposes. The three **continental areas** comprise the forest margin zones of Southeast Asia (montane and insular), Latin America (the Amazon Basin), and sub-Saharan Africa (the Congo Basin). Within each of the continents we focus on a few countries with high (past/current) rates of deforestation (Brazil, Cameroon, Indonesia, Peru, Philippines, Thailand) and these are classified according to broad agroecological zone. At the local scale within each country, **benchmark areas** are selected where the intensive fieldwork is conducted. Within the benchmark areas a number of **communities/villages** are chosen to represent a range in demographic conditions, land-use histories, and land-use typologies. The **farm or household** refers to the unit of study within the community. The information gained at the farm/household level will be valuable to the national and global assessments, not only for ASB but for the MA as a whole. Finally, many of the indicators are expressed at the plot (land use) level.

b) Special attention is given to the scaling rules in the biophysical domain, and the reasons for properties such as carbon stocks or total water yield to scale with area while properties such as regularity of river flow or biodiversity change by other rules, dominated by the 'lateral flow' component. In the socio-economic domain, scaling rules for economic indicators are relatively straightforward where financial capital is involved, but complex for indicators that are related to 'social capital' and human decisions to move or migrate. The latter require separate study at each scale.

c) User needs are explicitly recognized at the level of the household (farm), local (sub-district or equivalent) government and provincial or national government through active dialogues. A key challenge for ASB is to know how plot-level data can be scaled up to farm or community level, for

example to link biological diversity with socio-economic indicators, such as profitability. Preliminary studies in Sumatra and Northern Thailand indicate some progress in this area.

1.2.2.2. Were the scales at which you conducted your assessment appropriate and useful? If you were to repeat this study, how would you have defined the scales differently?

Because ASB is primarily a problem-driven research consortium, scales of analysis and reporting were defined with reference to specific user problems. In some cases, this process of identifying the appropriate scale for analysis and reporting has been a research activity in itself extending over a period of several years. For example, see the collection in Tomich et al. (2004) (Annex 2).

1.2.2.3. How were selected scale levels influenced by data availability?

Again, because ASB has existed as a research consortium for over a decade, it was feasible to pursue a process of (a) problem identification, (b) scale clarification/definition, (c) methodology adaptation or development, and (d) measurement to create necessary databases.

1.2.2.4. How did this influence the assessment? (e.g. outcomes, process, stakeholder involvement, responses)

In the primary data collection stage for the ASB benchmark sites, scales were primarily recognized in the sense of a 'stratified sampling' scheme. Reconciliation between remote sensing data, existing agricultural statistics for administrative units and the farm or plot-level data is still a major challenge. In the domain of 'watershed functions' we probably made most progress in understanding the cross-scale issues that relate plot-level (or macropore) changes to landscape-level outcomes. In the case of biological diversity, 'gradsect' sampling greatly enhanced the identification of indicators across scales.

1.2.2.5. How were the managerial capabilities important to your problem distributed across the scale levels (defined above) and were they appropriate?

It is fair to say that many ASB partners and users lacked capacity to grapple with the full range of scales that emerged in the research program and that are reflected in the assessment. ASB has invested effort in developing managerial capacity at its benchmark sites and within national consortia and in developing capacities in regional facilitation and global coordination and governance. In the process, appreciation of the complexity of ASB's roles also has evolved, particularly at the global level. S. Liu's study of ASB impact pathways highlighted the role of the ASB Global Coordination Office, which has developed as a 'boundary organization' spanning multiple scales and various functional spheres of influence (http://www.asb.cgiar.org/PDFwebdocs/AbrgSLiuASBImpact_May04.pdf).

1.2.2.6. Do existing managerial structures mimic the scale characteristics of your assessment?

Yes, in part, since ASB is intended to meet users' needs. But there are also important gaps. From the research and development perspective, the ASB consortium has, as noted above, helped develop capacities at benchmark sites, national, regional (in some, but not all, regions) and global levels. Of course, farmers

provide the management from the plot to household level. There is a wide variation in management structures at the community level, from highly sophisticated in some long-established communities to non-existent in some recent settler communities. Sometimes these exist side by side. The case was similar for national level structures compared across the six ASB countries. Relevant managerial structures (i.e., related to ecosystem management and balancing tradeoffs) typically are spotty, imperfect, or non-existent at the levels of landscapes and watersheds and also at the trans-boundary and global levels.

1.2.2.7. How have you sought to ensure information flow across these scales, and how have you reflected the different user needs across scales?

Information flow across the global, national and local levels has been achieved through the composition of the ASB benchmark site teams, which include local, national, and international scientists as well as NGOs and farmer groups; through the ASB thematic working groups; national ASB committees; and the ASB global steering committee. More complete information flow to local and national groups will be addressed in the next stage of the user needs assessment. Although ASB has considerable experience in participation with specific groups, this activity will move ASB to the next level of challenge, namely how to articulate participation across multiple groups with conflicting interests. A national and local user needs assessment was conducted in 2003/4 by building systematically on techniques from participatory research and development and bringing in new insights from political science, particularly the tools of participatory power mapping. A comparative approach to local and national user needs assessment, based on protocols developed during the 2003 pilot phase (section 1.3.5.3), should increase practical understanding of challenges at specific sites as well as providing insights regarding the most effective and efficient means to secure participation of key local and national stakeholders in seeking solutions when there are conflicting interests regarding ecosystem services. Indeed, without this strategic analysis, those local and national user needs assessments either would not be feasible or would not be able to produce general insights. An analytical framework and typologies of key stakeholders will be developed from those assessments along with comparative lessons and process-based insights across three or more ASB sites regarding the most efficient and effective means to identify and consult with these varied stakeholder groups.

1.2.2.8. Did the choice of scale for the assessment generate power (privileges) of certain groups over others? What were the political consequences of the scale choices made? How will/do these contribute to decision-making and public policy processes in the assessment?

These questions have not yet been addressed explicitly. The ongoing Strategic Stakeholder Analysis (see section 1.3.5 below), which is linked with the ASB-MA user needs assessments, may reveal some insights on this in the coming year.

1.2.2.9. How do you think your assessment has global relevance, if ANY?

The humid tropical broadleaf forest biome (Olson et al., 2001) is the 'problem domain' of the ASB program, and the ASB-MA assessment activities aim to cover six major ecoregions within this biome. This biome is recognized as the most biologically diverse among terrestrial systems. Put differently,

conversion of humid tropical rainforest to other land uses results in the highest loss of biodiversity per unit area of any terrestrial system. The ASB-MA focuses its efforts on the interface between the humid tropical rainforest and forest-derived land uses. The landscape mosaics that typify the margins of the humid tropical forest belt are extensive in area as well as being areas of rapid land use change, intensification, and degradation; as such, ecosystem services in these areas are also changing rapidly. Many of these changes in ecosystem services are important globally, such as loss of carbon stocks in vegetation and soils, with concomitant increases in atmospheric greenhouse gases. In addition, because biological diversity is high in these areas, deforestation is leading to high rates of biodiversity loss. The loss of these global public goods and ecosystem services highlights the tradeoffs between the provisioning services utilized by local and national (and even international) stakeholders with the regulating and even supporting ecosystem services that are valued by the global populations. Interventions at the landscape mosaic scale may provide a means of reconciling some of these tradeoffs and conflicts.

1.2.2.10. What surprising aspects or questions emerged from your chosen scale(s) of analysis? (unexpected outcomes, options, power relationships, etc.)

There have been many. Three that arguably are among the most significant are:

a) although there are some win-win opportunities, the dominant pattern across the humid forest margins is one of tradeoffs between local development options (involving clearing natural forests) and global environmental concerns (involving conserving natural forests). Restoration of degraded landscapes is perhaps the major area for win-win opportunities. (http://www.asb.cgiar.org/PDFwebdocs/Policybrief5.pdf)

b) an emerging (but still to be fully established) result is that landscape and watershed scale issues are much more localized in the scale of their effects than widely believed (see the collection of papers in a special issue of *Agriculture Ecosystems and Environment* (2004) (listed in Annex 2)).

c) shifting cultivation for subsistence food production is seldom the main cause of tropical deforestation. Other forms of agricultural expansion—practiced by smallholders and large landowners alike—tend to be much more important. But the most significant determinant is how these land uses interact with, and are affected by, macroeconomic forces, access to markets and a host of other policy and institutional factors. (http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief6.pdf)

1.2.2.11. Which issues and variables are scale-dependent, and which are scale-independent?

Carbon stocks are essentially scale-independent while biodiversity, nutrients, trace gas fluxes, water, agronomic sustainability, profitability, risk, food security, employment generation and most other institutional issues and national policy concerns are scale-dependent. Also certain land use systems—but not all—are somewhat scale-dependent (e.g., monoculture oil palm plantations) due to the infrastructure and institutional capacity needed for rapid post-harvest processing.

1.2.2.12. Lessons learned concerning the process, methods, tools or approach of conducting the assessment.

The assessment guidelines developed by the ASB consortium included information needs for the different scales. Teams were able to gather the general information needed to characterize the general biophysical and socio-economic conditions, and the land use typologies for the benchmark focal areas, as well as detailed information on land use (carbon stocks, GHGs, sustainability, profitability) at the farm level. As the information from the land-use and farm level was assessed it became more apparent that information at the watershed, landscape, and community scales was vital for understanding the connections/interactions between land uses and their overall effects on the environment (biodiversity, hydrology) and the agronomic/economic sustainability of the farms and communities.

1.2.3. Bridging scales and epistemologies

(Contacts: T Tomich, M van Noordwijk, L Joshi, F Sinclair, D Russell, P Ericksen)

1.2.3.1. How do different scientific disciplines interact at a sub-global level? What are the synergies and challenges among disciplines and within local knowledge systems? What are the power dynamics at play?

ASB conducted an on-line consultation (http://www.asb.cgiar.org/forum) with the participation of more than 40 ASB scientists to document consensus and divergence in their views on cross-discipline, functional, spatial, temporal, and knowledge system integration as well as organizational adaptation/learning and participation, using an analytical framework developed by Clark et al. (2002). The consultation concluded in January 2004 and the results were presented at the MA workshop on Bridging Scales and Epistemologies in Alexandria, Egypt, in March 2004.

1.2.3.2. Define and describe the knowledge relevant to ecosystem services (provisioning, supporting, regulating, and cultural) in your context in terms of: source, category, content, distribution (who are the carriers of knowledge?), and mechanisms of transmission. Describe how knowledge is conveyed or the nature of the knowledge and its conveyance system.

ASB has not yet conducted a systematic assessment on these important issues. There are, however, a number of relevant (and highly practical) approaches to these topics which we hope to explore in the future, including the literature on indigenous knowledge and environmental learning (especially work by F. Sinclair and L. Joshi), integrated natural resource management (Campbell and Sayer, 2003), policy research, and negotiation support (van Noordwijk et al., 2001). Several of these approaches owe much to earlier work on farming systems research (e.g., Byerlee et al., 1982) and participatory methods (e.g., Chambers et al., 1989). More recent literature on boundary organizations (Guston, 2001 (applied to ASB by Liu, 2003)) is quite relevant to the potential mechanisms of transmission of information among local

communities, scientists, civil society, and policymakers. For a problem domain in which tradeoffs and conflicting interests are rife, conflict management is a major challenge, specifically regarding scope for developing and distributing relevant knowledge across groups with conflicting interests.

1.2.3.3. What is the process of knowledge change and learning? How are knowledge systems added to or reduced and combined to cope with social and ecological change? How does knowledge appropriation affect human well-being? What are the processes (drivers) that cause change in ecological IKS? At what scale do the drivers operate?

Initial findings from the efforts to contrast 'local', 'public/policy' and 'scientists/modelers' ecological knowledge suggest that further analysis can help in reducing conflict and finding practical solutions. Local ecological knowledge on e.g., watershed functions is 'process- based' and well articulated for observable phenomena such as overland flow, erosion, sedimentation and filter effects. It does not depend on strict 'land use categories'. By contrast, public or policy 'knowledge' is based on such categories and the attributes that are supposed to go along with 'forest' and 'non-forest' land cover. Science can potentially bridge 'process' and 'pattern' based understanding and can usefully interact in both arenas. Progress in actual stakeholder negotiations can come from developing a shared articulation of the underlying cause-effect relations and the criteria and indicators that can reflect the various concerns. Breaking through existing categories at the policy level, and especially recognizing the 'intermediate' systems and forest mosaics as the focus of interest in natural resource management requires a change to 'evidence-based' discourse.

Exploration of the local knowledge of the ecological interactions in the complex agroforests in SE Asia suggests that these systems are managed on the basis of surprisingly simple concepts, rather than on intricate knowledge of component interactions. This contrasts with the knowledge that is articulated on interactions in simpler agroecosystems. In some of the studies the ecological knowledge of 'newcomers' or migrants can be compared with that of long-term inhabitants. For knowledge that is process based, such as that in soil and water movement, ecological knowledge can be readily adapted to new environments, while knowledge of the specific properties of plants and animals is more location specific.

1.2.3.4. Is there a mismatch or incompatibility between local practice/knowledge processes and ecosystem processes? If Yes, is it because conditions have changed? (e.g., because it is a newly established community because of a policy change).

Exploration of local knowledge of soil and water movement has lead to the concept of an 'implementation gap', where awareness and knowledge of environmentally beneficial practices does not necessarily lead to action and implementation. In some of the benchmark areas land use practices differ between ethnically different groups, even though the ecological knowledge at the level of explanations does not differ much. Migrants in the 'forest margin' originating from areas with more intensive land use take time to 'unlearn' and adapt to the less-intensive management that tends to be more profitable (over time) as well as environmentally benign. However, in cases in Sumatra where migrants could interact with, work for (learn

by doing) or at least observe well-established local practices and where they were free to adjust their practices, this adaptation process appeared to be remarkably quick. On the other hand, adaptation was retarded in government schemes where there were few local examples to emulate (colonization in the far western Amazon of Brazil) and in which (inappropriate) cropping patterns were dictated by a scheme (Transmigration in Indonesia). Moreover, while existing channels for agricultural extension are not very effective, they are in general less in tune with extensive and intermediate forms of land use than they are with intensive ones. The imperative for active, experiential learning derived from farmers' direct interaction with a new (or changing) environment is likely to be highest under conditions of extreme environmental heterogeneity and complexity (Tomich, 1992, albeit for a very different environmental context).

ASB has not yet addressed the following six sets of questions (1.2.3.5-10), but some preliminary ideas are included below. Our colleagues, Fergus Sinclair and Laxman Joshi, have a great deal of experience relevant to these topics.

1.2.3.5. Do people practice what they know and when do they practice or mobilize it? What are the barriers or constraints or incentive structures that prevent or discourage people from acting on their knowledge? How does knowledge relate to management and practice?

Indigenous communities at the forest margins clearly implement generational knowledge in farming systems. Immigrant populations also practice what they know but are more often than not prone to error in biophysical environments beyond their experience. Extreme events such as market shocks, El Niño droughts, etc. may interrupt traditional cultivation cycles.

1.2.3.6. How do changing opportunities (economic, political, social, educational) enhance or take away from use of indigenous knowledge for *ecosystem management?* (See section 1.2.3.5 above.)

1.2.3.7. What kinds of knowledge are transmitted between generations? How does this happen? What is the effect of this transmission or non-transmission? How are losses prevented? How are core elements or principles of the knowledge maintained?

Knowledge handed down from generation to generation is key to survival in many slash-and-burn systems. This may be highly sophisticated, as in Mayan and Aztec farming systems. Major socio-economic impacts including war, disease, and genocide can and do lead to breaks in generational knowledge transmission.

1.2.3.8. What are the barriers or bridges (e.g., organizational structures) to scientific knowledge entering into or being combined with local knowledge systems, and/or vice versa (i.e., local knowledge systems engaging with scientific) (as relevant to your context)?

The barriers include difficulty in 'translating' between these knowledge systems and the social barriers between these subcultures.

1.2.3.9. What is the role of local knowledge in back-casting and forecasting ecological changes? How is this knowledge used in coping with ecological changes? In what ways can local knowledge be scaled up or otherwise made relevant to policy-making and other planning processes at the global and national level?

Most indigenous communities are well versed in understanding weather patterns and accompanying ecological changes using local indicators within typical annual cycles. However in order to scale up, local knowledge must be formatted within the context of regional or global questions and knowledge-based protocols. Within each ASB ecoregional benchmark site local knowledge is important in understanding history of land use, cultivation methods, fallow systems, etc. Linkages of this kind facilitate comparisons of land-use impact within and between regions.

1.2.3.10. What are the new and unprecedented processes (e.g., globalization, policies and land uses, increased climate variability) that challenge local knowledge? What are the impacts of these processes on the local system? What are the aspects of the local knowledge system that can deal with variation, uncertainty and surprise?

Local communities are surprisingly well adapted to take advantage of uncertain events such as unforeseen El Niño droughts, which can predispose normally incombustible forests to burning and clearing. Less certain are the mid- to long-term outcomes of such weather events.

1.3. Assessment process

(Contacts: T Tomich, SJ Velarde)

1.3.1. Participants

There are three broad categories of ASB-MA participants: scientists, from both the South and North, who are conducting the assessment; farmers and other local users who are the intended beneficiaries of ASB's efforts; and policymakers and others who shape policy at various levels from local to national in the six ASB countries. ASB-MA engagement with farmers and other local users focuses on residents within ASB's network of long-term benchmark sites, which span the humid and subhumid broadleaf forest biome (see Figure 1). Engagement with scientists, local and national user groups is discussed below in sections 1.3.5.2-3.

1.3.2. Impacts on ASB of MA partnership

From the outset, a number of perceived benefits of partnership with the MA were apparent from the perspective of ASB. These included (a) broader context and expanded relevance of ASB's global synthesis, (b) links with more powerful channels for scientific dissemination, public awareness, and new channels for policy impact, (c) accelerated opportunities for enhanced participation, (d) access to global

assessments and datasets, (e) new opportunities for training and capacity building, and (f) funding and collaborative fundraising. To a varying extent, each of these benefits has already been realised.

Collaboration with the MA certainly has accelerated and expanded the scope of the long-planned ASB global synthesis, for which the ASB-MA activities now form the core effort. In particular, while similar elements between the ASB approach and the MA conceptual framework provided easy entry points, there are new dimensions that ASB had not previously explored. First, although ASB researchers had been concerned with driving forces since inception of the program and there was a recent renewed interest among our national partners, associations through the MA led ASB to develop a very fruitful collaboration with researchers in the Land Use and Land Cover Change (LUCC) group. This effort has already produced an ASB *Policybrief* on forces driving tropical deforestation: http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief6.pdf. Second, exposure to methods for participatory formulation and use of scenarios has generated real excitement within ASB. Among the national partners participating in the ASB-MA inception meeting in March 2003, scenarios were—unexpectedly—an area of great interest. The Global Steering Group of ASB has identified training in scenarios as a priority for ASB fundraising. These tools would greatly enhance ASB capacity to integrate work across temporal scales, something which has not received a great deal of attention to date. Finally, and most recently, those of us in ASB who are involved directly in the sub-global working group have been stimulated by the introduction to 'bridging epistemologies', another topic where ASB's potential contributions may not have been realized without interactions through the MA.

ASB staff recently initiated an exciting discussion with MA outreach specialists regarding ways in which ASB can develop a communication strategy to feed into various MA channels. It is a great advantage to our program to be able to produce smaller products that can then fit into a larger effort, since our public awareness and media production capacities are limited. Association with the MA also prompted us to move faster on strategic stakeholder analysis, and provided some funding to initiate that effort. Similarly, the association also has accelerated the process of reaching consensus on a new ASB data policy and provided both technical advice and impetus (by creating opportunities for exposure) to efforts to enhance public access to key ASB datasets. Although our success in raising funds for ASB-MA activities has not been as great as we hoped, we of course are very grateful for the 'seed' and 'core' grants to ASB from the MA secretariat. Moreover, this crosscutting assessment by ASB is contributing directly to establishing the scientific basis for design of the Rainforest Challenge Partnership, which is a major new collaboration. (http://www.asb.cgiar.org/RC.shtm)

1.3.2.1. Lessons learned concerning the process, methods, tools or approach of conducting the assessment. Note: many of the topics covered below were elaborated based on results from the on-line ASB process documentation activity, which was completed in January 2004 (Tomich et al., 2004, http://www.asb.cgiar.org/PDFwebdocs/Tomich_etal_2004_TheChallengeofIntegration_2.2.pdf ; Tomich et al., 2006).

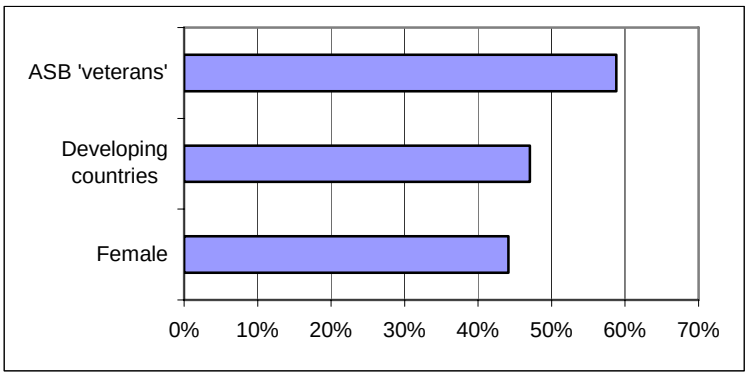
Standardized protocols and appropriate methods allowed us to compare a variety of ecosystem services and livelihood factors in diverse land use systems throughout the humid forest margins. Since sites were chosen to represent a range in land use intensity, driving forces, and ultimate land use, such an approach was extremely valuable in providing insights into the similarities and difference among the sites and possible factors that explain them. Arranging for the various ecosystem services and outcomes in terms of human well-being to be assessed at the same locations (ASB benchmark sites) was crucial for achieving meaningful interactions and understanding among the different disciplines, particularly for bridging the biophysical and social sciences. This methodology also highlighted the tradeoffs among ecosystem services. The results will also be useful for developing scenarios for the different sites.

Increasingly, it is appreciated that ecosystem assessment and management in the tropics needs to evolve from a focus on neat categories to an acknowledgement of the chaotic reality in the field, with a large number of actors making their own decisions, disregarding official plans, maps, rules, and academic categories and typologies. In terms of response options, the best job outside actors (research and development agencies) can do will often be to facilitate and support a process of negotiation among these stakeholders, who frequently have conflicting interests among various ecosystem goods and services (van Noordwijk et al., 2001).

Work by the ASB-MA team in a CGIAR on-line course in October 2002 reinforced this point. A strategic perspective on stakeholder involvement is needed, since the lists of potential stakeholders far exceed our capacity for consultation and interaction (http://www.asb.cgiar.org/ma/inception/2.1_Stakeholders_list_DThomas.doc). This provided the impetus to move forward with efforts at more 'strategic' stakeholder analysis to guide priorities for user needs assessments (see section 1.3.5.3).From the beginning of activities in 1994 to date, ASB has concentrated on producing scientific outputs (e.g., the ASB matrices mentioned in section 2.5), but has devoted much less attention to understanding and documenting the processes and institutional innovations that have made this possible. A collaboration with the Initiative on Science and Technology for Sustainability at the Kennedy School of Government at Harvard University (http://www.sustainabilityscience.org) has provided an analytical framework for analyzing ASB's approach to "Institutional challenges for harnessing science and technology for sustainability" (Clark et al., 2002). Two process-oriented studies have been pursued as part of the ASB-MA activities: a study of ASB's impact channels (Liu, 2003); and an on-line consultation among ASB participants to document areas of consensus and divergence about key ASB organizational processes (see Figure 3 for participants).

Capacity for integration (bridging disciplines, functional mandates, spatial and temporal scales, and knowledge systems) is of central interest for analysis by ASB of its own experiences. The framework encompasses other elements too—including institutional learning and adaptation; participation (both for legitimacy and discovery); and strategies for managing resource and capacity constraints—on which ASB has considerable experience and where process-based insights might be relevant for the MA. A facilitated virtual consultation (comprising current and past ASB coordinators and other coordination office staff, ASB Global Steering Group members, and active scientists and other stakeholders) was used to document key ASB organizational processes from various perspectives. This broader participatory approach has the great advantage of triangulating the perceptions of processes and key turning points in ASB's development from the perspective of a large number of those involved. Based on an initial ASB-MA team experience in October 2002 with a CGIAR on-line course for 'high-performance teams', it was decided that a structured activity of this type would work well in an asynchronous, virtual format with facilitated on-line process documentation. However, there was also an option to participate by email for those without good www access. The first session on challenges of integration was completed in November 2003. The second session on organizational learning, participation, and adaptation to resource constraints was conducted in January 2004. This on-line consultation produced a multi-authored paper for the MA Bridging Scales and Epistemologies Meeting in Alexandria, Egypt, in March 2004. See revised paper at http://www.asb.cgiar.org/PDFwebdocs/Tomich_etal_2004_TheChallengeofIntegration_2.2.pdf

Figure 3. Description of participants in the ASB on-line documentation process



1.3.3. What mechanisms have been established for the governance and/or authorizing environment of your assessment (e.g., advisory committee and terms of reference)?

ASB is a system-wide program of the CGIAR. A Global Steering Group (GSG), comprising senior scientists appointed by the following institutions is the governing body.

- Agency for Agricultural Research and Development (AARD), Indonesia
- Center for International Forestry Research (CIFOR), Indonesia – current GSG Chair
- Centro Internacional de Agricultura Tropical (CIAT), Colombia, including the Tropical Soil Biology and Fertility Institute (TSBF)

- Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Brazil
- Institut de Recherche Agricole pour le Dévéloppement (IRAD), Cameroon
- Instituto Nacional de Investigación Agraria, (INIA), Peru
- International Food Policy Research Institute (IFPRI), USA
- International Institute for Tropical Agriculture (IITA), Nigeria
- Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Philippines
- Royal Forest Department (RFD), Thailand
- World Agroforestry Centre (ICRAF), Kenya, (host institution of the system-wide program)

The Global Steering Group meets annually to make decisions on annual budgets and workplans. ASB operational procedures and policies are established by the GSG and published in the minutes of its meetings. ASB is led by a global coordinator based in Nairobi at the headquarters of the host Institution, the World Agroforestry Centre (ICRAF). The global coordinator is directly responsible to the Chair of the Global Steering Group and the Directors of ICRAF.

1.3.4. How is the technical work of the assessment structured?

The structure of the ASB-MA activities builds on the thematic priorities and standardized methodologies developed since 1994 by ASB thematic working groups, and which are reported in a recently published ASB book (see Annex 1). For each of the assessment topics, indicators have been developed that reflect user needs and concerns regarding specific outcomes, focusing on land use, land cover change, and resource management. These include protocols for:

- Benchmark site characterization and multi-scale assessment (see Palm et al., 2000).
- Assessment of global environmental services: carbon stocks and greenhouse gas fluxes (http://www.asb.cgiar.org/WG_climatechange.shtm) and aboveground vegetation biodiversity (http://www.asb.cgiar.org/WG_biodiveristy.shtm)
- Assessment of belowground biodiversity (see Bignell et al. (2005), referenced in Annex 1) and agronomic sustainability at the plot level (see Hairiah et al. (2005), referenced in Annex 1).
- Assessment of social and economic issues (http://www.asb.cgiar.org/WG_socioecon.shtm) including smallholder farmers' and national policymakers' concerns. These include: measures of output and profitability, valued at both private and socially adjusted costs and benefits; labor requirements, including the establishment and operational phases for various land uses; means of meeting household food security; and institutional capacities, such as existence and functioning of markets for purchased inputs and outputs, labor, and capital, access to technological information, property rights and resource access, equity issues, and degree of social cooperation.

These plot-**level indicators** have been measured for **locally-significant land uses** at ASB benchmark sites in four countries: Indonesia, Cameroon, Brazil, and Peru (http://www.asb.cgiar.org/Publications.shtm), with additional development in Northern Thailand. The data on indicators for the specific land uses are compiled in a format referred to as the **ASB matrix** (http://www.asb.cgiar.org/gallery/ASB_matrix.ppt) (see Figure 4 below), which facilitates assessment of tradeoffs across land uses (see Tomich et al. (2005), referenced in Annex 1).

Figure 4. ASB matrix

Meta Land Uses	Global Environmental Concerns	Agronomic Sustainability	Smallholders' Socioeconomic Concerns	Policy & Institutional Issues
Natural Forest				
Forest Extraction				
Complex, Multi-strata Agroforestry Systems				
Simple Treecrop Systems				
Crop/Fallow Systems				
Continuous Annual Cropping Systems				
Grasslands/Pasture				

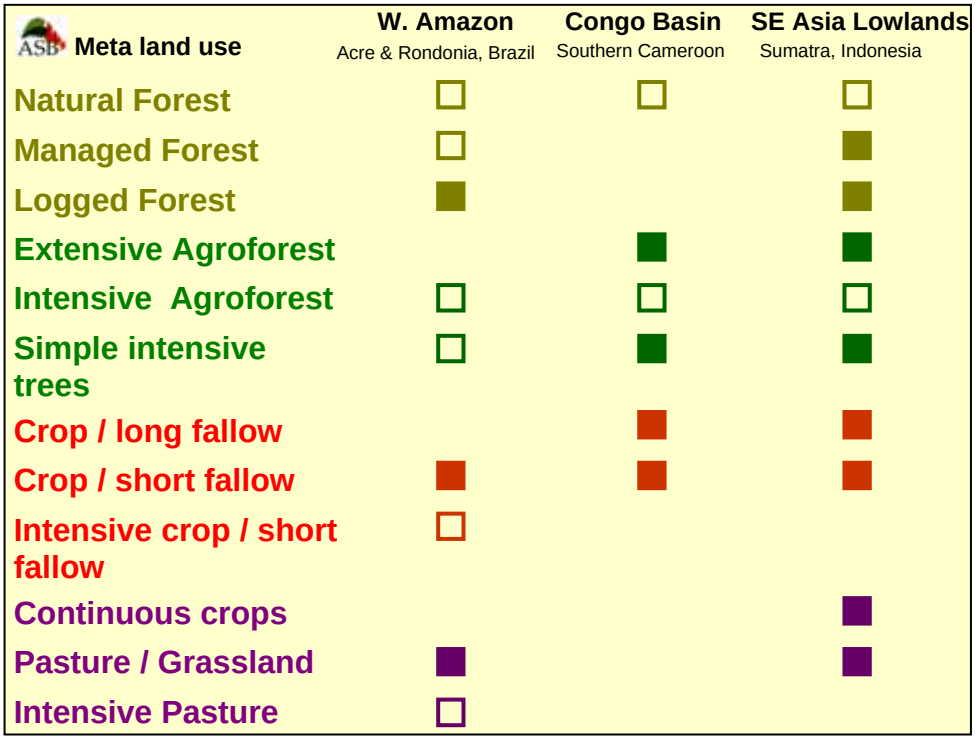
In order to facilitate cross-site (and intercontinental) comparisons within the biome, land uses for benchmark site assessments were also selected with reference to a set of '**meta land uses**' (http://www.asb.cgiar.org/docs/ASBmetalanduse.ppt) (see Figure 5). Similar indicators have been developed for **landscape mosaics** in Northern Thailand (see Thomas et al., in press).

Indicators for output of **ecosystem goods** (providing services) underlie the profitability indicators described above and will be derived from those existing databases and other secondary data (see section 2.2.1 and Annex 8); work on this is ongoing.

In 2002 and 2003, assessment activities were extended to include **hydrological functions** and their coincidence with biologically significant habitats at various scales, from the local/landscape scale to medium-sized river basins (the Mekong) to the pantropic scale. (See ASB BNPP implementation protocols, technical reports, and databases: http://www.asb.cgiar.org/BNPP/phase2.htm)

Taking existing ASB methods and databases as the point of departure, this structure was revised and extended by participants in the ASB-MA inception meeting in March 2003, which produced the zero-order outline for the ASB-MA assessment (http://www.asb.cgiar.org/ma/inception/asb-ma_v6.0.htm#outline).

Figure 5. Meta land use diagram



TP Tomich

Summaries of Tradeoffs Matrices for Benchmark Sites in Brazil, Cameroon, and Indonesia

Table 1. ASB summary matrix for the Brazil benchmark site (adapted from Vosti et al. 2001; Gillison, 2000; and Hairiah et al., Palm et al. and Vosti et al. in Tomich et al. (2005), listed in Annex 1).

	GLOBAL ENVIRONMENTAL CONCERNS		*AGRONOMIC SUSTAINABILITY*[b]			*NATIONAL POLICYMAKERS' CONCERNS*		*SMALLHOLDERS' CONCERNS / ADOPTABILITY BY SMALLHOLDERS*	
LAND USE SYSTEMS	*Carbon storage*	*Bio-diversity*	Plot-level production sustainability			*Potential profitability*[c]	*Labor require-ments*	*Returns to Labor*[c]	*Household food security*[d]
	Above-ground tC/ha (time-averaged)[a]	*Above-ground plants (#species per standard plot)*	*Soil Structure*	*Nutrient Export*	*Crop Protection*	*Returns to Land (private prices) R$/ha*	*Labor (person-day/ha/yr)*	*$/person-day (private prices)*	*Entitlement Path (Operational Phase)*
Forest	148	80	0	0	0	-2	1	1	na
Managed Forestry	~148	nm	0	0	0	416	1.22	20	$
Coffee/ *Bandarra*	56	27	-0.5	-0.5	-0.5	1955	27	13	$
Coffee/ Rubber	56	16	-0.5	-0.5	-0.5	872	59	9	$
Traditional Pasture	3	10	0 to -1	-0.5	-0.5 to -1	2	11	7	$ + consumption
Improved Pasture	3	nm	0 to -1	-0.5	-0.5 to -1	710	13	22	$ + consumption
Annual/ Fallow	7	34	0 to -0.5	0 to -0.5	-0.5 to -1	-17	23	6	$ + consumption
Improved Fallow	~3-6	26	0 to -0.5	0 to -0.5	-0.5 to -1	2056	21	17	$ + consumption

Notes to Table 1:

'nm' indicates not measured; 'na' indicates not applicable.

[a] Indicates time averaged aboveground carbon (see Palm et al. (2005) listed in Annex 1)

[b] For Agronomic Sustainability: 0 indicates no difficulty, -0.5 indicates some difficulty, -1 indicates major difficulty.

[c] Prices are based on 1996 averages, and expressed in December, 1996 R$ (US$=R$1.04), discounted at 9% per annum.

[d] For Food Security, 'consumption,' and '$' reflect, respectively, whether the technology generates food for own-consumption or income that can be used to buy food, or both.

Table 2. ASB Summary matrix for the Cameroon benchmark site (adapted from Gockowski et al., 2001; Kotto-Same et al, 2000; Gillison, 2000; and Hairiah et al. and Palm et al. listed in Annex 1; from Tomich et al. (2005), listed in Annex 1).

	GLOBAL ENVIRONMENTAL CONCERNS		*AGRONOMIC SUSTAINABILITY*[b]			*NATIONAL POLICYMAKERS' CONCERNS*		SMALLHOLDERS CONCERNS / ADOPTABILITY BY SMALLHOLDERS	
LAND USE SYSTEMS	*Carbon storage*	*Biodiversity*	Plot-level production sustainability			*Potential profitability*[c]	*Labor require-ments*[d]	*Returns to Labor*[c]	*Household food security*[e]
	Aboveground tC/ha (time-averaged)[a]	*Aboveground plants (#species per standard plot)*	*Soil Structure*	*Nutrient Export*	*Crop Protection*	*Returns to Land (private prices) $/ha*	*Labor (person-day/ha/yr)*	*$/person-day (private prices)*	*Entitlement Path (Operational Phase)*
Forest	211	76	0	0	0	Nm	nm		$
Oil palm	61	nm	-0.5 to -1	-0.5	-0.5	722 -1458	93	1.81-2.44	$ + consump-tion
Extensive cocoa	61	63	-0.5	-0.5	-1	424-943	65	1.63-2.13	$ + consump-tion
Intensive cocoa	61	63	0	-1	-1	889-1409	107	1.95-2.36	$ + consump-tion
Food crop/ long fallow	63	53	-0.5	0	0	283	44	1.70	$ + consump-tion
Food crop/ short fallow	4	63	-1	-1	-1	623	115	1.79	$+ consump-tion

Notes to Table 2: same as Table 1, except

[c] Prices are based on the averages of the different establishment systems, from forest or fallow, for oil palm and whether fruits are sold or not in the cocoa systems, and expressed in (US$), discounted at 10% per annum.

Table 3. ASB Summary matrix for the Indonesian benchmark site (adapted from Tomich et al., 2001; Tomich et al., 1998; Gillison, 2000; and Hairiah et al., Palm et al., and Vosti et al., listed in Annex 1; from Tomich et al. (2005) listed in Annex 1

	GLOBAL ENVIRONMENTAL CONCERNS		*AGRONOMIC SUSTAINABILITY*[b]			*NATIONAL POLICYMAKERS' CONCERNS*		*SMALLHOLDERS' CONCERNS / ADOPTABILITY BY SMALLHOLDERS*	
LAND USE SYSTEMS	*Carbon storage*	*Biodiversity*	*Plot-level production sustainability*			*Potential profitability*[c]	*Labor require-ments*	*Returns to Labor*[c]	*Household food security*[d]
	Aboveground tC/ha (time-averaged)[a]	*Aboveground plants (#species per standard plot)*	*Soil Structure*	*Nutrient Export*	*Crop Protection*	*Returns to Land (private prices) $/ha*	*Labor (person-day/ha/yr)*	*$/person-day (private prices)*	*Entitlement Path (Operational Phase)*
Forest	306	120	0	0	0	0	0	0	na
Community-based forest management	120	100	0	0	0	5	0.2 to 0.4	4.77	$ + consump-tion
Commercial logging	94	90	-0.5	0	0	1080[e]	31	0.78	$
Rubber agroforest	79	90	0	0	-0.5	0.70	111	1.67	$
Rubber agroforest with clonal planting material	66	60	-0.5	-0.5	-0.5	878	150	2.25	$
Oil palm	62	25	0	-0.5	0	114	108	4.74	$
Upland rice/bush fallow	37	45	0	-0.5	-0.5	-62	15 to 25	1.47	consump-tion
Continuous cassava/ imperata	2	15	-0.5	-1.0	-0.5	60	98 to 104	1.78	$ + consump-tion

Notes to Table 3: same as Table 1, except

[a] Time averaged C from Tomich et al. (1998) and Palm et al. (2005) this volume

[c] Output prices are based on ten year (1988-1997) averages, and expressed in real US $ in 1997 (US$=Rp 2400 in 1997), discounted at 20% per annum.

[e] Social prices, rather than private prices, were used for logging (see Vosti et al. (2005) listed in Annex 1). Here, 'social prices' means adjusted for factor market and trade policy distortions; however, values have not been adjusted for environmental externalities or public goods.

1.3.4.1. How were the scientists involved, identified and selected? What disciplines do they represent?

Scientists involved in the assessment are drawn from three main sources. First are the, roughly, 250 scientists from about 50 institutions who have been involved in ASB over the years since its inception in 1994. Second, in order to augment the expertise of ASB scientists and to bring in a broader range of perspectives, some additional scientists with established expertise in the relevant fields were also invited to participate. A targeted open call for expressions of interest was circulated by email to about 200 potential scientific participants in September 2002. Finally, additional suggestions were solicited from participants in the ASB-MA inception meeting, which was held in Kenya, 17-19 March 2003, and which involved 36 participants drawn from various ASB sites and partner institutions. Among the 36, 18 participants (50%) are from developing countries and 13 (36%) are female (see participants' list, http://www.asb.cgiar.org/ma/inception/Annex H.htm). The process is open and we continue to add contributing authors as qualified individuals are identified and express interest in collaboration.

By June 2005, 102 scientists had expressed interest and were involved in ASB-MA activities. Of these, 36% are female and 56% are developing country nationals. Regarding disciplinary balance, 23% are trained as biophysical scientists, 39% as agricultural scientists, and 38% as social scientists (mainly economists and geographers) (http://www.asb.cgiar.org/ma/asb-ma_authors_stats.doc). (See Figure 6).

A significant core group of ASB-MA team members have collaborated actively for several years. International experts (both within ASB and from outside the global consortium) were identified primarily based on their expertise in the topical areas noted above (carbon stocks, greenhouse gas fluxes, aboveground vegetation biodiversity, belowground biota, agronomic sustainability, social, economic and policy issues). Many of the international experts—and all of those who already were involved in ASB—participate directly in research at ASB benchmark sites. National experts are mostly from national agricultural and forestry research institutions and national universities.

1.3.4.2. How much expertise came from local users, partners and other stakeholders?

Capacity building is a central objective and an ongoing task of ASB. Over the years, the partners in the consortium have broken new ground by bringing together (often for the first time) scientists from different kinds of institutions—national agricultural research systems (NARS), universities, NGOs, international centers and advanced research institutions (ARIs)—for collaborative activities at the ASB benchmark sites. Scientists from Asia, Africa, and Latin America have interacted frequently at the benchmark sites, thereby providing new pantropical perspectives as well as comparative insights. They have worked with farming communities at the benchmark sites as well as government policymakers and leaders of international institutions in the capital cities. Interdisciplinary consensus and teamwork was forged out of frequent and intensive contacts. The challenge of integration across disciplines, functional mandates, spatial and temporal scales, and knowledge systems is the main topic of the on-line consultation. A wide range of premises regarding the determinants of integration have been tested in on-line polls, and areas of consensus and divergence have been explored through facilitated discussions in which nearly 40 ASB scientists have

actively participated. Conclusions were presented at the MA meeting on Bridging Scales and Epistemologies in March 2004.

In many cases the national partners in ASB were from agricultural institutions and were strong in certain aspects of the assessment (food, feed, and fiber provisioning) but did not have prior experience regarding environmental services, particularly concerning global issues. Training and team building was a long and sometimes difficult process but giving national partners the responsibility for the assessment proved crucial to establishing equal partner status and getting the job done. Now many are established leaders in their countries on environmental issues and the experience with global issues has been a distinct professional advantage for a number of individuals. In many cases ASB has become a major thrust in the national institutions. One of the reasons for this has been the involvement of national leaders as active members in the ASB consortium and the Global Steering Group.

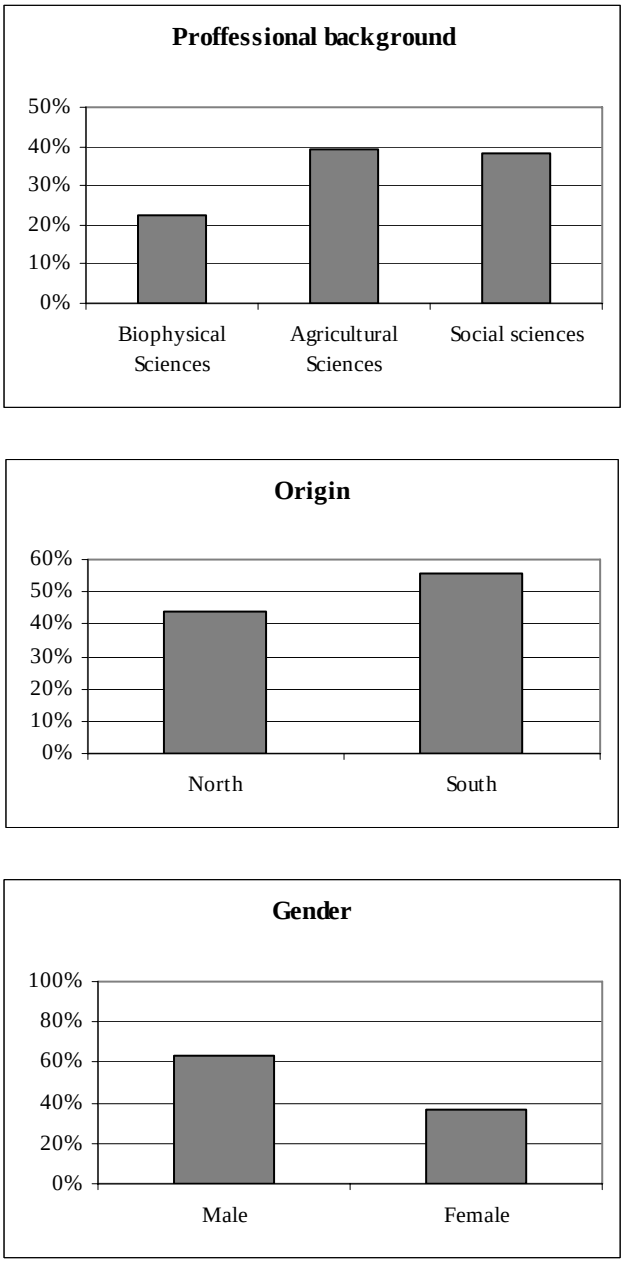
1.3.4.3. How long did it take?

ASB was born out of two recommendations of the 1992 Rio Earth Summit, appearing in Chapter 11 (Combating Deforestation) of Agenda 21: “Limit and aim to halt destructive shifting cultivation by addressing the underlying social and ecological causes” and “Reduce damage to forests by promoting sustainable management of areas adjacent to the forests”. Significant funding for the ASB system-wide program began in 1994. ASB continues to operate as an integrated research and development program.

Thus ASB assessment activities build on a decade of research results, development experience and capacity building in the humid tropics. Partnership with the MA was sought as a vehicle for syntheses of these results and also to place the ASB insights within a broader scientific context and to reach a wider and more varied audience. ASB initiated contact with the MA Secretariat in response to a call for proposals in October 2000. Formalization of the proposed partnership was approved by the ASB Global Steering Group at its annual meeting in November 2001 and ASB was approved by the MA panel in January 2002. Consultations among ASB partners were conducted informally during 2002 in parallel with ASB-MA fundraising efforts. With support from the MA Secretariat, an ASB-MA inception meeting was held in conjunction with the annual ASB Global Steering Group meeting in March 2003 to launch pilot assessment activities in 2003

ASB activities over the past 10 years have included development of conceptual frameworks, indicators, methods, and databases for a number of topics where these did not previously exist.

Figure 6. Summary data of ASB-MA authors



Moreover, since ASB has been from its outset multi-disciplinary, multi-institutional, multi-scale and with activities dispersed across sites spanning the tropics, these elements have added to challenges of coordination of the program. On the other hand, because sites, scientific teams, methods, databases, and (perhaps most importantly) connections with local and national users were already well established, these advantages enabled ASB partners to initiate the assessment rapidly.

1.3.4.4. Were there conflicts of interest between users of the assessment and other stakeholders and how were they addressed?

This question is being addressed in the ongoing 'strategic stakeholder analysis' and will be reported later (see section 1.3.5.3). A related issue of differing interests and priorities among scientists engaged in ASB from different disciplines, institutions, and across spatial and temporal scales was discussed in the on-line process documentation activity (section 1.3.2.1), which was reported at the MA Bridging Scales and Epistemologies meeting in 2004 (Tomich et al., 2004 (http://www.asb.cgiar.org/PDFwebdocs/Tomich_etal_2004_TheChallengeofIntegration_2.2.pdf); Tomich et al., 2006).

1.3.4.5. What kind of methodology dealing with data, models and scaling should be used?

(Contacts: SJ Velarde, P Muraya)

Protocols have been developed by ASB thematic working groups regarding methods, models and data (http://www.asb.cgiar.org/Publications.shtm#WGReports) for the major topics covered in the ASB-MA assessment. ASB's thematic working groups cut across benchmark sites and involve scientists from a range of institutions who share an interest in a particular thematic focus, such as belowground biodiversity or policy analysis.

At the annual meeting of the ASB Global Steering Group (GSG), on 20-21 March 2003, the GSG adopted a data sharing policy for ASB as follows: ***"****ASB encourages free dissemination of its work when reproduction and use are for non-commercial purposes, provided all sources are acknowledged. ASB follows a policy of open, public access to its datasets."*

In conjunction with ASB-MA activities, a consultant has prepared a comprehensive set of recommendations regarding implementation of this ASB data policy in order to achieve the objectives of thorough documentation and public availability of ASB datasets (http://www.asb.cgiar.org/data/datapolicy.doc). These recommendations will be considered by the ASB Global Steering Group during its meeting in December 2004. MA metadata protocols are being followed.

1.3.4.6. Constraints to the ASB-MA assessment process so far

The primary constraint has been funding. Despite significant efforts to identify sources of funds, and active assistance in fundraising from the MA Secretariat, we have been less successful in raising funds for the ASB-MA activities than anticipated. Funding constraints have affected the ASB-MA assessment in two ways. First, limited funding has significantly reduced opportunities for scientists to meet face-to-face to understand the assessment process (which is new to most ASB partners) and to work together on the ASB-MA assessment. We have explored on-line consultations and email lists as means to form 'virtual teams', with some success. However, virtual teamwork is not a substitute for face-to-face interaction. Fortunately, the MA Secretariat was able to provide a grant that enabled us to conduct an inception meeting. Second, limited funding has affected the ability of some scientists to participate in the process.

Although the ideal is that the staff time for all scientists participating in the assessment would be supported by their own institutions as an in-kind contribution, this is not always the case. Indeed, some of the candidate lead authors are independent and will not be able to participate without some funding for their time. To accommodate these funding constraints, the assessment activities in 2004 relied primarily on electronic communications. Initial outputs will be structured and released as separate ASB *Policybriefs* (see Annex 3 for issues to date). Later these will be compiled and revised to form a comprehensive assessment product.

There are particular funding concerns for 2004 regarding ASB-MA plans for work on conditions and trends. One is regarding funding to conduct the statistical and GIS analyses necessary to derive the relative contribution, to the aggregated supply at the sub-national and national level, of food, fiber, and feed production in the forest margins. This will be used in the assessment of provisioning services for the ASB benchmark sites (section 2.2.1). Another is regarding funding to complete the nested pantropic assessment of the impact of deforestation on water supply (section 2.2.2.3). Finally, much more could be done on assessment of resource base and supporting services (section 2.2.3), including, in particular, biological diversity (section 2.3.2.2) and ecological knowledge (section 2.2.3.3), and on developing the framework for analyses of human well-being, sustainable livelihoods, and poverty reduction (section 2.4).

Specific areas of institutional capacity also are a constraint. Because ASB partners are mainly research and development organizations, as mentioned above 'ecosystem assessment' is a new concept to almost all participants. While assessment methods are similar, the overall approach to assessments (in contrast to research) is not well understood. However, appreciation of the role and utility of assessments is growing and this is one area where additional capacity building would be worthwhile.

ASB partners have little expertise in formulation or use of scenarios and this is our most specific capacity constraint. There has been strong interest in scenarios methods among ASB partners who have been exposed to these ideas through the MA. Training in formulation and use of scenarios has been identified as a top priority for capacity building in the ASB consortium. Fortunately, thanks to a grant from the Government of Netherlands to ICRAF with support from trainers from the MA Scenarios global support unit, an ASB-MA Scenarios training course was conducted in Chiang Mai, Thailand, from 17-23 November 2004 for participants from all ASB countries. Additional funding has been made available in 2005 for course participants to conduct participatory local and national scenarios exercises for the various ASB benchmark sites/countries and these experiences will be synthesized through an on-line consultation in 2006.

1.3.4.7. What resources are being drawn on to undertake the assessment (e.g. funding, in-kind contributions, partnerships)?

The ASB-MA assessment would not be possible without the existence of the ASB System-wide Program of the CGIAR. ASB is a global partnership for research, development, and capacity building that has existed for more than a decade. Assessment activities are built on the ongoing work of the system-wide

program, which has activities amounting to roughly USD 5-7 million per year. Of this total budget, approximately 10-15% is for the ASB global coordination office, which leads ASB synthesis activities, including the ASB-MA work.

Specifically the ASB consortium funds coordination and salaries of the one of the coordinating lead authors, two research associates, and one administrator. Funding from the Earth Institute at Columbia University is providing the salary for the other coordinating lead author. Funds for the inception workshop have come from the MA as have the funds for the ongoing assessment of national and community user needs. There are insufficient funds at this time to conduct the entire sub-global assessment, so 2003 was a pilot assessment where certain areas already covered in ASB work were synthesized and linked to global levels.

Some of the main funding sources directly relevant to ASB-MA activities include:

- Seed grant to ASB from MA Secretariat (2002): USD 7,458.
- Core grant to ASB from MA Secretariat (2003-2004): USD 80,000.
- World Bank Netherlands Partnership Program Grant for ASB-MA activities regarding the nexus of tropical hydrology, biodiversity, and poverty (2001-2003): USD 621,916.
- Netherlands Junior Professional Officer (JPO) Grant, ASB Pan-tropic Ecosystem Assessment: USD 244,602.
- Grant from the World Agroforestry Centre (ICRAF), with funding from the Government of the Netherlands Strengthening Institutions Project, for ASB-MA Scenarios training course and ASB-MA scenarios training toolkit: USD 65,742.
- Small Grants Programme from the World Agroforestry Centre (ICRAF), with funding from the Government of the Netherlands Strengthening Institutions Project, for ASB-MA scenarios exercises: USD 20,000.

1.3.4.8. What is the time frame/schedule for your assessment?

- ASB abstract submitted to MA: October 2000.
- Approval in principle by ASB Global Steering Group: November 2001.
- ASB concept note submitted to MA: December 2001.
- Approval by MA Panel: January 2002.
- Call for expressions of interest from scientists within and outside ASB: September 2002.
- Inception meeting: March 2003.
- Pilot phase: 2003.

- Main assessment phase: 2004-2007, including the following:
    - ASB-MA Provisioning Services workshop, October 2004, Nairobi, Kenya.
    - ASB-MA Scenarios training course, November 2004, Chiang Mai, Thailand.
    - ASB-MA local scenarios, 2005, Piura, Puerto Maldonado and Ucayali (Peru), Rondonia (Brazil), and Mae Khong Kha (Thailand).
    - ASB-MA scenarios online exchange of lessons learned and ASB-MA scenarios training toolkit, mid 2006.
- Review and outreach: 2005 –2008.

1.3.5. Users and synthesis of their needs

(Contacts: D Timmer, D White, T Tomich)

1.3.5.1. How was the need for the sub-global assessment decided?

The ASB Global Coordinator is responsible for leading global synthesis of ASB results. The opportunity to link the ASB global synthesis with the MA was identified by Dr. Andy Gillison, who leads the ASB Thematic Working Group on Aboveground Biodiversity. Andy Gillison and Thomas Tomich, who is the current ASB Global Coordinator, prepared a concept note for the call for sub-global assessments and initiated exploratory discussions with Walt Reid.

1.3.5.2. Who decided and who else was involved?

Based on the exploratory discussions, the ASB Global Coordinator prepared an information presentation for the ASB Global Steering Group (see section 1.3.3) for their annual meeting in November 2001. At that meeting, the GSG gave conditional approval for the Global Coordinator to prepare a proposal for ASB to conduct a sub-global assessment. That proposal was approved by the GSG in December 2001 and submitted to the MA panel for consideration in their meeting in January 2002. ASB Global Coordination workplans and budgets, including ASB-MA activities, are reviewed and approved by the ASB GSG annually.

1.3.5.3. How are users being engaged in your assessment, and how have user needs been ascertained?

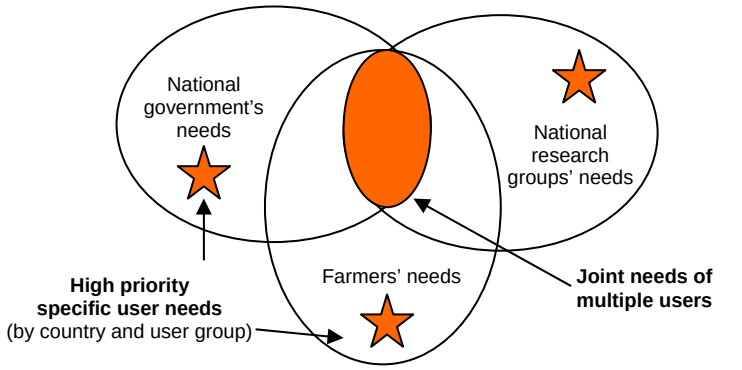
Sustained collaborative research activity by ASB partners has facilitated the establishment of benchmark sites in the Amazon of Brazil and Peru, the Congo Basin forest of Cameroon, the island of Sumatra in Indonesia, the northern mountains of Thailand, and the island of Mindanao in the Philippines. Through this network of sites that spans the humid tropics, ASB ensures that its analyses of local and national perspectives are grounded in reality. At each benchmark site, ASB partners work with households to understand their problems, opportunities, and constraints. Similarly, consultations with local and national policymakers provide insights into the often-conflicting perceptions of these problems, opportunities, and constraints. In this way, participatory research and policy consultations guide the iterative process

necessary to identify and develop policy, institutional, and technological options that are workable and relevant.

From the outset, the ASB consortium involved multiple partners in the science community (international and national) who interacted on the critical factors for assessment and the development and use of standardized methods for assessing those factors at remote sites. Directors of national research institutions, with influence at the national level, were also involved from the beginning – establishing ASB goals, objectives, and research programs. Both the field scientists and directors are one category of user. During the course of the ASB process many of the national partners within ASB have become influential with/in regional and national organizations.

User needs assessments at the national level were reported for Thailand and were assessed for local and national levels in Brazil in 2003. Extensive consultations were completed for Indonesia, Cameroon, and Peru by mid-2004. These user needs assessments seek to identify joint needs and concerns of multiple users, plus a number of additional high priority needs of individual users at both a country and user group level (see Figure 7). These users needs assessments build systematically on techniques from participatory research and development and bringing in new insights from political science, particularly the tools of participatory power mapping.

Figure 7. User needs approach from the MA



User needs assessment graphic modified from MA (2002)

Results of these five sets of consultations are reported in Annex 7, along with a synthesis of assessment questions based on these user needs assessments. These will be the starting point for the teams formed to work on specific assessment topics. With the appointment of a new ICRAF coordinator for the Philippines, who has significant experience with the MA, it is hoped that this MA consultation process can be extended to the Philippines in the future. Results from specific ASB-MA consultations in the Philippines and from the continuous process of consultation among ASB users will also shape the work of the assessment teams.

1.3.5.4. Community assessments

Since its initiation, community level assessments have been a key part of the ASB process and production of guidelines. Most of the field work and interviews have been conducted within several communities within each benchmark area (see Palm et al., 2000). Profiles of communities residing at ASB benchmark sites are included in Annex 6. The interviews and associated research provide an overall picture of land and resource use by the farmers in the communities and of the opportunities, problems, and constraints that they face. These are portrayed from an individual perspective in the ASB '*Voices'* (see Annex 4), a series that "aims to convey for a broad audience the insights and perspectives from people's real-life experiences and challenges in the humid tropics".

The national ASB consortia, which include local user groups at the ASB benchmark sites, have the potential to become vehicles for participation for diverse groups within the countries concerned, and thus a platform for user-driven ecosystem assessment and, ultimately, for conflict management. Although ASB has considerable experience in participating with specific groups, this activity will move ASB to the next level of challenge, namely how to articulate participation across multiple groups with conflicting interests. Some work along these lines already is underway in Indonesia (van Noordwijk et al., 2001) and in Thailand (http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief7.pdf).

It is planned that a number of the community assessment 'template questions' will be addressed during ASB-MA work on human well-being and ecosystem services. The template questions are included as Annex 5 of this report for ready reference.

1.3.5.5. Consultations with policymakers and policyshapers

ASB's policy research priorities are driven by the needs of two broad groups of users: smallholders living in the humid tropical zone spanned by ASB's mandate; and the policymakers who influence the range of choices available to these smallholders. Just as participatory methods help us to understand smallholders' objectives and constraints, consultation with policymakers at various levels is a hallmark of ASB's client-driven approach to policy. Many of the forces driving deforestation, environmental change, and natural resource degradation arise outside the forestry and agricultural sectors (see http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief6.pdf), and hence are beyond the control of officials in those ministries. Therefore, impact of ASB's policy research on the twin objectives of poverty alleviation and improved resource management depends on decisions taken by a wide range of policymakers and those who advise them ("policyshapers"). ASB policy consultations and follow-on research are intended to identify workable options to further these public policy objectives and to support the efforts of those policymakers who share these objectives. ASB's approach to policy issues starts by understanding policy problems and workable responses at the local and national level as a means to ultimately draw strategic insights about problems that are shared by many countries in ASB's mandate.

Environmental and natural resource policy has, necessarily, to address issues at local, regional, national, and global scales. As a result, ASB has had to develop new methods and to build new partnerships with

institutes that have relevant skills in modeling regional, watershed, and economy-wide policy issues. ASB's approach is not the only way to pursue strategic policy research. However, it fits well with ASB's comparative advantage in plot, household, and ecoregional approaches, ASB's commitment to ongoing work in certain developing countries, and the complexity and context-specificity of policy problems related to natural resource management.

As ASB's body of research results has grown, the ASB Global Coordination Office has explored means to influence policy decisions at global and regional levels extending beyond the six ASB partner countries. The ASB *Policybriefs* series (see Annex 4 for a list of issues) is one of the main products of the ASB Global Coordination Office. This series aims "to deliver relevant, concise reading to key people whose decisions will make a difference to poverty reduction and environmental protection in the humid tropics". As noted above, going ahead this series will feature ASB-MA topics as intermediate outputs that will be consolidated into comprehensive assessment products after a full range of topics are completed. ASB has also expanded its engagement with the World Bank, including collaborative assessment activities and briefings for Bank staff in December 2003, funded by a grant from the Bank Netherlands Partnership Program (as part of ASB-MA activities) and with environmental organizations such as the World Conservation Union (IUCN) and the World Wildlife Fund (WWF) through its Rainforest Challenge Partnership (http://www.asb.cgiar.org/RC.shtm).

1.4. Utility of the MA conceptual framework

(Contacts: T Tomich, C Palm, SJ Velarde)

1.4.1. Is the model useful at the scale of your assessment?

Yes, definitely. See Section 1.3.2. above for discussion of some specific examples.

1.4.2. What are the challenges or synergies that you would like to highlight?

The ASB concept was launched in 1992 and the program began operations in 1994, years prior to the development of the MA conceptual framework. So it is interesting to see that the ASB framework and MA conceptual framework have many of the same components: driving forces, conditions (and trends) in resources; poverty (human well-being); and interventions (responses). ASB also shares with the MA the features of being multi-disciplinary, multi-institutional, and multi-scale. Moreover, both approaches recognize that ecosystem services are important locally and globally and that policies and actions at remote (national, regional, and global) scales can affect local actions and conditions (and vice versa). The MA framework has taken the ASB assessment further by helping make more specific links between the services and human well-being and also in the introduction of scenarios.

The fact that ASB is a sub-global assessment but includes a (nearly) global scale has made it possible to see that there can be a disconnection between the condition of the local ecosystem provisioning and the

regulating services – particularly when the drivers (or demand) are external to the local scale (e.g., in-migration, commodity prices, etc.). In such circumstances the 'community' stewardship of the services may not be sufficient to maintain them, and the external demands for goods or pressures (driving forces) are not able to respond in sufficient time to avert the deterioration of services. The reverse case can also be made: local human conditions of 'unwell-being' (e.g., poverty, food insecurity) may be drivers of changes (deterioration) in both provisioning and regulating ecosystem services. In many cases the change in ecosystem services is 'felt' at the global level and while the distant or global populations are interested in maintaining these regulating services, they are unaware or not interested in the human conditions that drive those changes.

1.4.3. What are alternative conceptual frameworks (written, oral, or visual) that help your assessment conceive of the dynamic relationship between human well-being and ecosystem services?

ASB has made seminal contributions to the evolving integrated natural resource management (INRM) paradigm employed by the CGIAR and its partners. This INRM model is characterized by a process-oriented, systems approach at multiple scales, with participation of multiple stakeholders and an emphasis on measurement and scaling of tradeoffs and impacts across alternatives: http://www.asb.cgiar.org/gallery/INRM_paradigm.jpg . Although the INRM approach remains in its early stages, the following characteristics have been identified by ASB as integral components of the process:

- **Problem analysis.** INRM in ASB starts with problem analysis. An integrated analysis of a broad range of land use alternatives must quantify the local, national and global benefits they entail as well as the institutional realities that may favor or hinder their further development in three distinct dimensions: (1) **enhanced biological productivity**, (2) **enhanced ecosystem integrity and resilience**, and (3) **enhanced human well-being.**
- **Analysis of tradeoffs, ranges of flexible options.** ASB researchers summarize the indicators of local, regional and global benefits of a range of land use options in a matrix format, and then analyze the tradeoffs and synergies for a range of management intensities within the major systems (Tomich et al., 1998). For the land use practices that are attractive from a local economic perspective as well as a global environmental perspective, we analyze the various factors that influence farmer decision-making, including the economic and institutional (dis)incentives provided by current policies.
- **Iterative feedback and participatory learning.** A major outcome of ASB activities has been a contribution to policy dialogues at the local and national level on the ways forest functions can be maintained in the context of development. For example, official recognition of the valuable role of agroforests and other sustainable land use systems at a national and local level provides a first step towards empowering the farmers that manage these systems.

Part II. Ecosystem Services, Conditions and Trends

2.1. Summarize how the conditions and trends were defined in your assessment

(Contacts: C Palm, T Tomich)

The services provided by tropical forests and the forest-derived agroecosystems at the forest margins are diverse and include the provision of goods (food, fuel, timber, etc.) demanded locally, nationally and internationally. In addition, they regulate locally-important environmental services, and others that are important regionally or even globally (water, carbon sequestration—including atmospheric regulation—air quality, nutrient supply, and regulation of pests and diseases).

Natural or undisturbed forests were considered as the reference or baseline condition against which other forest-derived systems could be compared. ASB assessed subsets of conditions and trends at the global, benchmark, landscape, and land-use (plot) level.

2.1.1. What was the reference or baseline condition?

Undisturbed natural forest is the **plot level** reference point for the ASB matrix framework (described in section 1.3.4 above). Pristine natural forest is rare in many of the ASB benchmark sites, so this reference point is something of an abstraction. In practice, the standard was forest that had not been cleared or logged for a century or more and that had not been exploited heavily for non-timber forest products. Regardless of scale, land cover change is the focus of all ASB analysis of conditions and trends.

By assessing the various ecosystem services along an intensification of land use gradient ranging from natural forest (or a proxy) to grasslands and pastures, we are able to quantify or infer temporal trends in land use at the landscape and benchmark scales.

Although there are exceptions among the various benchmark sites, there has not yet been a systematic, program-wide effort to translate land cover change into analysis of condition and trends of specific ecosystem services at various scales. However, the recent work on water (described below) does attempt to do this for scales ranging from a field to the entire tropics.

At the **local/plot** scale the conditions of specific services were assessed through measurements made directly in different land use types found at the humid forest margins. In addition, land use intensity gradients (including chronosequences) were selected to represent the change (or trend) in conditions expected with deforestation and intensification of land use. The land use systems and intensity gradients sampled at the benchmark sites fit into a few meta land use systems, representing various stages of intensification. Natural or undisturbed forests served as the reference point for assessing the condition of ecosystem services. Managed and logged forests were included in this category because in most locations undisturbed forests were not found. Complex agroforestry systems were the next category of land use in the intensification sequence. These systems include a wide diversity of plant species, and usually have a fairly

long rotation time, e.g., greater than 20 years. The other meta land use systems, in increasing level of land use intensity, include: simple tree-based systems and tree crop plantations that usually contain less than 5 plant species; crop-fallow rotations, including short-term fallows, improved fallows, and long-term fallows characteristic of shifting cultivation; continuous food crop systems; and finally pastures/grasslands, including degraded grasslands and improved pastures. Intensive, plot-based surveys aim to sample representative fallow stages to infer chronosequences. In a number of cases, overall plant-based 'signatures' can be acquired for a fallow cycle in one farming system despite changes in species and functional types during the successive fallow stages. Current research in Thailand and Sumatra suggests this 'signature' may be potentially useful in upscaling plot-based data in a way that can be matched against farm level profitability.

2.1.2. What was the time frame over which you evaluated the trend?

Time frames for analysis of trends in land cover change (focusing on deforestation) differ from site to site, depending on the availability of land cover data and spatial analysis capacity. The time frame for which the trends are evaluated for the benchmark areas is determined by the availability of land cover/land use maps or other information on changes in land use. Thus far in the assessment this has only been done for carbon (and water) in the Indonesian benchmark areas. Changes in land cover of the different land use systems were determined from a 1986 vegetation map and a 1992 Landsat TM image. For the Cameroonian benchmark area, change in forest area up to 1995 was assessed via population growth figures (assuming population growth was the main driver of land use change), and the change in forest area was related to changes in carbon sequestration. In Brazil, a survey of land use change within the benchmark area between 1994 and 1996 is available; in addition the Brazilian team have projected areas of different land use categories in the next 25 years using several policy options, and related such changes to carbon sequestration. Land use change maps are also available for the Peru benchmark site.

2.1.3. How were the effects of scale, spatial heterogeneity, and uncertainty handled?

Spatial scale is discussed above in section 1.2.2. ASB research includes a wide range of methods that are chosen depending on local and national user needs, data availability, and skills available at specific sites. Thus, there is no uniform answer to the question regarding spatial heterogeneity and uncertainty. The gradsect approach applied to aboveground biological diversity assessment in most sites does not incorporate random sampling and thus cannot be used to estimate error terms and levels of uncertainty. On the other hand, the statistical models employed in gradsects are more efficient than standard probability-based estimates for detecting the distribution of biota. The resulting spatial models derived via gradsects can be statistically evaluated by predictive tests using ground truth.

The ASB matrix is the technique that has been most widely (and uniformly) applied across ASB benchmark sites (with the exception of Mindanao). As explained in section 1.3.4 above, the matrix uses a 'representative land use' approach (local examples of the ASB 'meta land uses'). This approach is designed to be readily replicable in order to obtain comparable data across the tropics and to seek broad,

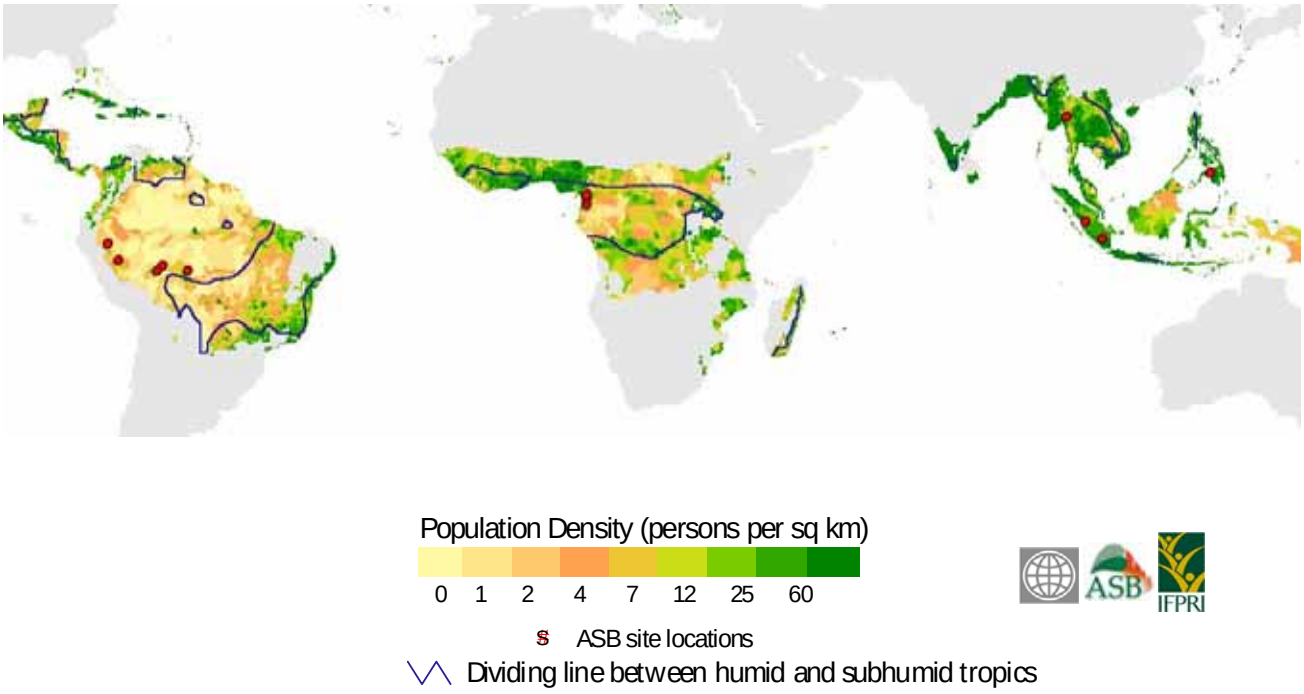
robust patterns. It is suited more to the search for central tendencies, and it not a good means for identifying probability distributions. So while the ASB matrix is a useful tool for a first cut at broad patterns in cross-site comparisons, it has also been necessary to employ other techniques to better handle spatial heterogeneity and uncertainty. A potentially useful set of questions to be taken up in the ASB-MA activities in 2004 could be to assess the strengths and weaknesses of the various techniques used in this regard, with the ASB matrix approach as a benchmark. **Forthcoming ASB-MA assessment products will follow guidelines in 'Millennium Assessment Methods' (p. 73) regarding qualitative terminology to describe uncertainty.**

2.1.4. What are the key features of the socio-economic and governance context?

The key differences in socio-economic conditions across the ASB benchmark sites include **population density** (http://www.asb.cgiar.org/gallery/pop_density.ppt) (see Figure 8), daily **wage rates** for agricultural labor, **farm size**, **profitability** of different land use systems, and access to **markets**. Data on these factors have been collected and analyzed at each benchmark site. ASB-MA activities provide an opportunity to place the benchmark site-level data in a broader, pantropic context and to explore the differences across sites.

There are also dramatic differences in the 'governance context' across sites, which have very different historical, cultural, political, and institutional legacies despite some remarkable similarities in biophysical features across sites. **Food security** is one aspect of governance that has been a particular focus of interest for ASB and is of paramount interest to many users at the local and national level as well as for intended beneficiaries. There are big differences among the governments in ASB countries in their commitment and capacity to intervene constructively to enhance food security across a range of scales from national to individual.

Figure 8. Population density of the humid and subhumid tropics (1995)



Source: Global Population of the World (CIESIN, 1999).

A second set of key issues in the 'governance context' concern **land and tree tenure** and other aspects of **property rights and natural resource access**. These have received considerable attention, both within the ASB program and by other researchers and there is a rich modern literature on these issues.

Many important feedbacks—both positive and negative—are postulated between **human health** and land cover change, especially deforestation. Unfortunately, ASB has had little capacity within the program to explore these links. Now, because of emerging collaborations within the Amazon Basin (both in Brazil and Peru), it may be possible to include some of these issues for that specific region. However, it is unlikely this could be done for the Congo Basin or for ASB sites in SE Asia under the current time frame.

2.1.5. What ecosystem services have you chosen to analyse in your assessment?

2.1.5.1. How did you make this choice, and why?

Choices were discussed and decisions were made by participants during the ASB inception meeting held in March 2003 (http://www.asb.cgiar.org/ma/inception/asb-ma_v6.0.htm). The group started this process by developing a '**wish list**' for an idealized (but not completely unrealistic) ASB-MA assessment product (http://www.asb.cgiar.org/ma/inception/ASB MA Chapters.doc). This comprehensive outline contained **ecosystem goods** (food, fiber, feed, etc.), **regulating services** (carbon sequestration and air quality, water supply, nutrient supply, regulation of pests and diseases, and cultural and spiritual values), and **resource base and supporting services** (soils and soil formation, biological diversity, and ecological knowledge).

Next the group applied more pragmatic criteria—especially by considering what ASB studies were already in hand—to develop and **focus priorities** for assessment. Fortunately, two major ASB efforts were drawing to a successful conclusion during the same period. One of these is a book entitled *Slash and Burn: The Search for Alternatives* (Palm et al., 2005), which is a synthesis of the first decade of ASB research (see Annex 1 for contents). The other is a special issue of the journal *Agriculture Ecosystems and Environment* entitled *Environmental Services and Land Use Change: Bridging the Gap between Policy and Research in Southeast Asia* (Tomich et al., 2004), which considers three landscape scale issues: smoke pollution; biodiversity functions; and watershed functions (see Annex 2 for contents), and includes a synthesis paper that assesses each of these three topics. Although the volume focuses on SE Asia, many of the papers in the collection (especially the synthesis papers) have much wider relevance.

The 'priority list' includes ecosystem goods (of which food supply received particular emphasis from some users); the regulating services carbon sequestration and air quality; water supply; nutrient supply; and the resource base and supporting services, soil, soil formation, and biological diversity. (See Annex 7 for the synthesis of questions based on user needs for the various services and Annex 8 for procedures for the goods assessment.)

2.1.5.2. What other ecosystem services are perceived to be important, but will not be covered in detail in your assessment?

Two categories of clear importance—**regulation of pests and diseases** (of humans, plants and animals) and **cultural and spiritual values—**are unlikely to be covered in detail because of limited capacity and data within the consortium and limited time and other resources to develop new partnerships in these areas. Expertise on study of **ecological knowledge** is available among existing partners, but it may not be possible to generate sufficient resources to undertake this topic.

2.2. Towards assessment of conditions and trends in ecosystem services

2.2.1. Provisioning services: goods – food, fiber, feed, etc.

(Contacts: S Scherr (lead), L Joshi (lead), K Sebastian (lead), A Salazar, H Scheuch, J Bushby, D White, GB Nkamleu, Z Tchoundjeu V Robiglio, M Ngobo, C Legg, J Tonye, D Huasai, F Mirasol, M Locatelli, J Valentim, P Drumond, T Sá, S Budidarsono, A Fagi, C Hutacharern, H Weyerhauser, S Vosti, T Tomich, C Palm, SJ Velarde)

Food, fiber (including timber and fuelwood), feed for livestock, and a host of other major products are obtained from forests and the different forest-derived land use systems found at the tropical forest margins. The main products differ greatly by land use system, between and within regions, and also with changing conditions over time (e.g., during droughts). But regardless of their location, ASB-MA users typically rank these goods (and especially food and timber) as their top concerns among all ecosystem services.

Plot level methods and indicators: Since many of the land use alternatives involve perennials, time is an essential element in analysis of these production systems. Moreover, most of the relevant systems produce many types of outputs, which also vary over the cycle of the system. Profitability was estimated as the net present value (NPV) – the present discounted value of revenues less costs of tradable inputs (fertilizer, fuel, etc.) and of domestic factors of production (land, labor, management) over a 25-year period. The policy analysis matrix (PAM) technique provided the framework for estimating profitability indicators as well as the indicators of labor requirements and cash flow constraints discussed below. The PAM is a matrix of information about agricultural and natural resource policies and factor market imperfections that is created by comparing multi-year land use system budgets calculated at private and social prices (Monke and Pearson, 1989). In these calculations, efforts have been made to adjust 'social prices' to reflect factor market imperfections and trade policy distortions; however, values have not been adjusted for environmental externalities or public goods. All the resulting estimates are for specific land uses expressed at the plot level (1 ha).

Sub-national and national level methods and indicators: Our plan is to disaggregate these analyses by product and scale up the analysis through local, sub-national, and national statistics on area and output. The objective will be to derive estimates of the relative contribution of production of goods in the forest margins to aggregate supply at the sub-national and national level. A protocol for the ASB-MA ecosystem goods assessment was developed in June 2004 (see Annex 8). Based on these procedures, data are being compiled at ASB benchmark sites and for larger administrative units during August and September 2004. Partners from all ASB benchmark sites gathered in Nairobi, Kenya, from 4-7 October 2004 for a workshop entitled "Scaling Up the Goods Assessment" to develop plans and a written protocol for "scaling up" the analyses from benchmark sites to states/provinces and other larger units. Post-workshop tasks (from October 2004 to early 2005) included collaboration in analysis and assessment of major goods produced at the tropical forest margins within ASB ecoregions, development of spatial indicators for goods produced, and trend analyses of land use, production and yield as indicators of ecosystem condition and trends in sustainability.

Data: Yields and prices of specific products from the different land-use systems and associated labor inputs, wage rates and other production costs were obtained through household surveys conducted during ASB benchmark site characterization (see Palm et al., 2000). Typically these were compared with available official statistics and expert opinion to arrive at estimates for 'representative' land uses. Scaling up to sub-national and national level units of analysis will be based on official statistics.

Models: The policy analysis matrix framework of Monke and Pearson (1989), which is based on project appraisal techniques, was used for plot level analysis. As discussed above, scaling these analyses up to sub-national and national units will require statistical analysis of the extent of particular land uses, which is ongoing, probably also supplemented by GIS-based scenarios. Some ASB benchmark sites already have undertaken analyses at the sub-national and national scales (see Tomich et al. (2005) in Annex 1).

2.2.2. Regulating services

2.2.2.1. Carbon sequestration, including atmospheric regulation.

(Contacts: C Palm, R Lasco (lead), L Verchot (lead), O Cacho (lead), D Murdiyarso, T Sa, M Locatelli, K Hairiah, J Valentim, V.G.S. Rodrigues, J. Richey)

Carbon stored in tropical forests is vital to maintaining/reducing the level of greenhouse gases in the atmosphere. There is still considerable uncertainty in the CO_2 flux and storage from the tropics due to inadequate estimates for rates of different land-use transitions, the biomass of the vegetation that is cleared, the rates of re-growth, and levels of biomass recovery of the subsequent land-use systems. In particular there is little information on the C stored and the potential to sequester C in many of the land use systems of the humid tropics, other than for continuous cropping and pasture systems, both of which have low C storage potential. There is, however, significant tree cover on deforested, agricultural, and abandoned land in the rain-fed, or humid, tropics that could provide a potentially large sink for carbon. In addition to the greenhouse gas aspects of carbon sequestration, carbon storage in soils is essential for maintaining many ecosystem services including nutrient availability, water infiltration, and detoxification of certain minerals and chemicals.

Methods: The condition of carbon stored or sequestered in the aboveground vegetation and topsoil (0-40 cm) in the different land use systems was assessed directly through field measurements at each site according to standardized protocols http://www.asb.cgiar.org/WG_climatechange.shtm. Two to three sites, that included the land use intensity gradients, were chosen in each benchmark area and one or two replicate carbon measurements were taken in each of the land use systems at each site, resulting in three to six replicate measurements per benchmark area for each land use type. Five replicate 4 x 25m quadrants were randomly assigned to each land use plot. This information obtained at the plot level can then be applied to land cover and land cover change maps to assess trends in conditions over larger scales. So far this has been completed for the Indonesia and Cameroon benchmark sites.

Data: A database developed by ASB from the carbon stock measurements taken in each of the land use types at each site was used for assessing the condition of carbon sequestration in forests and agroecosystems. See ASB Climate Change working group report for Phase II at http://www.asb.cgiar.org/WG_climatechange.shtm.

Indicators: Since many of the land use systems (agroecosystems and tree plantations) in the humid forest margins are rotational, meaning that they are harvested and cleared periodically and then allowed to regrow, the carbon stored in these systems at the end of the rotation is the maximum carbon stored and is thus an overestimate of the carbon stock of those systems over their rotation. To account for the changes in carbon stocks from the harvest, clearing and regrowth phases, a time-averaged carbon index was calculated to indicate the average carbon stocks stored in each land use system over the rotation time of the system (Palm et al., 2004).

Models: The CENTURY model was calibrated for some of the benchmark areas and can be used for assessing changes in carbon stocks for different land use scenarios.

2.2.2.2. Air quality

(Contacts: T Tomich, D Murdiyarso)

Smoke pollution is a serious public health problem and disrupts livelihoods in large areas of the humid tropics. ASB-MA will review evidence available linking biomass burning to human health as part of activities in 2004. Prior ASB work has emphasized options to manage smoke from land clearing activities (see papers on smoke pollution in Annex 2). Fires are not intrinsically bad. They can, if managed well, be a legitimate low-cost technique for clearing unwanted vegetation. The challenge for policymakers is to minimize the adverse effects of fire and smoke, not to stamp out the use of fire. Available options are reviewed in ASB Policybrief No. 04, *Reducing Smoke Pollution from Tropical Fires* http://www.asb.cgiar.org/PDFwebdocs/ASBPolicyBriefs4.pdf.

2.2.2.3. Water supply

(Contacts: D Thomas, M van Noordwijk, T Tomich, C Vorosmarty, E Douglas, J Richey, S Wood)

Forest conservation often is cited as a means to maintain key hydrological processes and water supply, but quantitative evidence at policy-relevant scales is rare. One of the most frequently discussed services is that of hydrological integrity, such as the provision of sustainable water yields, reduction of flood hazard, and erosion control. Habitat conservation and integrated watershed management are intimately connected to the water cycle of humid tropical ecosystems. A recent assessment of available evidence for the humid tropics (see the paper by Bruijnzeel (2004) listed in Annex 2) indicates the role of natural forest cover in providing reliable water supplies to humans and their agroecosystems may be significantly overstated.

With funding from the World Bank Netherlands Partnership Programme (BNPP), ASB institutions in collaboration with researchers at the University of New Hampshire (UNH), the University of Washington (UoW), and the World Bank initiated in 2001 a multi-scale assessment of the relationship between land cover change and hydrological processes and of the overlap between areas of hydrological importance (or sensitivity) and significant biological diversity based on the WWF ecoregions (Olsen et al, 2001). The second phase of this project will be completed in December 2003, so potentially important new findings will be submitted for review in early 2004. The project is intended to assist the World Bank and its clients in project development and policy analysis by:

- providing systematic assessments, for significant areas of the humid tropics, of the *hydrological value* of forests with biodiversity significance in promoting local livelihoods and resilience to economic and environmental shocks; and
- assessing the nature, magnitude, geographical scope, and relation to poverty of these hydrological values and processes.

This project comprises two interrelated sets of activities. Activity 1, entitled "Pantropic/meso-scale Analysis and Synthesis", builds on preliminary work on biophysical and human geography undertaken in Phase I of this project. Phase I results demonstrated the feasibility of this approach for specific ecologically-based categories (viz., the humid and subhumid moist broadleaf forest zone – the tropical rainforest biome – of the WWF Global 200 Ecoregions) and of combining these with complementary data on human population distribution. The project has benefited from publication of new datasets, especially those compiled for the MA, in which several key project partners are active participants. New spatial tools produced by a UNH team were identified that could provide the basis for a coarse pantropic analysis of human vulnerability to degradation of certain hydrological functions.

In Phase II, IFPRI, which led Phase I work on this activity, has been joined by the UNH team. IFPRI, UNH, and other team members are applying these new tools and state-of-the-art datasets to "pantropic" mapping of three distinct problem domains: (1) biodiversity loss, as represented by globally-significant ecosystems; (2) relationship between land cover change and specific hydrological functions, with particular attention to water yield and flooding risk, represented using coarse scale synoptic models; and (3) human population densities. The overall goal of these activities is to identify locations within the humid tropics where the hydrology/biodiversity/poverty nexus is likely to be important; and to assess the size of the human population of these areas. The specific research activities, which include major efforts in data assembly, development of pantropic land cover change scenarios, synoptic modeling and simulation, and overlay of the problem domains are described in detail in research protocols available on-line: http://www.asb.cgiar.org/BNPP/phase2/protocols/impl_prot_act1_v2.0.doc.

Patterns of deforestation and other forms of land cover change in the tropics were used to evaluate the role of tropical biomes (including both managed and natural ecosystems), as a source of water and of flooding vulnerability. Combining existing regional-to-continental scale biogeophysical data sets, models, and policy-relevant scenarios, the pantropical domain (0.5 degree resolution) was analyzed through the prism of river network topology (i.e. the hierarchical organization of river systems and drainage basins). A drainage basin perspective is essential for understanding the upstream-downstream connectivity of water supplies, water demands, and emerging water problems.

Activity 2 of this project, entitled "Micro/meso Modeling of Hydrological Effects and Cross Scale Effects", builds on preliminary work on the scale of effects of land cover change on watershed functions in the humid tropics undertaken in Phase I. Phase I review of empirical studies and preliminary simulation results demonstrated (1) the importance of disaggregating the analysis for specific watershed functions (e.g., peak flow, base flow), (2) that this disaggregation could produce results that are more relevant to policymakers' and public concerns (e.g., flooding, seasonal water shortages), and, not surprisingly, that (3) various modeling strategies have strengths and weaknesses in addressing specific functions. A team at UoW was identified to augment the hydrological modeling capabilities of the lead team from the International Centre for Research in Agroforestry (ICRAF) in Southeast Asia.

In Phase II, the ICRAF Southeast Asia team, which led work in Phase I, the new University of Washington partners, and other team members are applying a suite of models with different structures and at different scales to test elements of an emerging consensus among hydrologists that raises fundamental questions about the relationship between hydrological functions and tropical deforestation. This emerging consensus is empirically based, but because of the difficulties and long-term nature of implementing hydrological experiments in the 'real world', physically-based simulation provides one important means of testing these propositions within a consistent framework and at multiple scales and thereby helping to explore gaps in evidence. These comparative physical modeling exercises are based on real datasets. Differences among the various hydrological models used in Activity 2, as well as the synoptic Water Balance Model (WBM) which also is used in Activity 1, are summarized in http://www.asb.cgiar.org/BNPP/phase2/bnpp_phase2_act2.roadmap.htm. While the results of these models are not conclusive by themselves, they are the best analyses possible at this time in terms of modeling expertise and data used. Moreover, these simulations are essential in controlling the (strong) effects of climate and terrain on specific hydrological functions and thereby in isolating the (weaker) effects of land cover, which is the focus of many interventions. The implementation plan for these nested hydrological modeling exercises and the structure and data requirements of each of the models is available on-line: http://www.asb.cgiar.org/BNPP/phase2/protocols/Activity%202%20Implementation%20Protocol_v6.0.doc.

2.2.2.4. Nutrient supply

(Contacts: M Swift (lead), C Palm, M Locatelli, F Agus, K Hairiah, J. Richey)

The continued productivity of land use systems depends on the supply of nutrients either through external inputs or internal cycling, the latter being an ecosystem service upon which many agroecosystems in the tropics depend. Depletion of nutrient stocks through the repeated harvest and removal of goods without replenishment of those nutrients will also result in a decline in the provisioning services of the agroecosystem; therefore various aspects of nutrient supply, stocks, and balances were assessed in the different land use systems.

Methods: Thus far nutrient supply and balance have been assessed only at the plot (land-use level). Nutrient inputs (kg per hectare per year in the form on mineral fertilizers or organic inputs) and nutrient outputs (kg per hectare per year in the form of crop yields and tree products) were calculated for each land use type at the benchmark sites. Nutrient inputs were assessed primarily through interviews with farmers at the sites but also through national or district level statistics (for mineral fertilizer use, if available). Nutrient contents of organic inputs were obtained from the literature. Nutrients removed through harvests were determined by the crop or tree product yield (obtained from field interviews and agricultural statistics) and multiplied by the concentration of nutrients in the different products (obtained from the literature, (Stoorvogel and Smaling, 1990). The nutrient balance was determined as the difference between inputs

and outputs for nitrogen, phosphorus, and potassium. The cost of nutrients in the form of mineral fertilizers and price of crops was obtained from local markets and statistics.

Data: Nutrient contents of crops and crop residues were obtained from Stoorvogel and Smaling (1990). Data on crop and tree harvest yields were obtained by direct interviews with farmers and, where possible, from district agricultural statistics.

Indicators: Two indicators were developed to assess whether the nutrient balance was (or could potentially be) maintained in the different land use systems: net nutrient export = nutrient input minus nutrients harvested; relative nutrient replacement cost = the export of nutrients in harvested products to the costs of putting them back into the agroecosystem in the form of chemical fertilizer.

2.2.2.5. Regulation of crop pests and diseases

(Contacts: M Swift, S Weise)

Pests and diseases of domesticated crops can often be controlled 'biologically' through natural parasites and predators that occur within the same agroecosystem or within patches of vegetation in the landscape. As agroecosystems are intensified they are often also simplified and contain less biodiversity, in such cases pests and diseases can occur at levels that affect the provisioning service of the system (crop and tree productivity and yields). Continued production of the same crops without rotation may also lead to increased pest problems. Similarly, as landscapes become more homogeneous with forest clearance and land use intensification then forest refugia for natural predators and pests disappear and pest and disease outbreaks become more common. In both situations the pest regulatory function, usually associated with biodiversity, at the plot or landscape scale is compromised.

Plot-level methods: Pests and diseases at the plot level were assessed in the different land use types through expert opinions of those working in the areas. Included in the categories were weeds, insect pests, fungal and bacteria diseases, and vertebrate pests. In this analysis there was no consideration of the surrounding land use types and vegetation, which can have important implications for pest management.

Plot-level indicators: Qualitative indicators were developed to indicate the severity of the pest problem and its possible effects on continued production of the agroecosystem (see Hairiah et al. (2005), listed in Annex 1). The indicator included three levels:

> [0] indicating no major problems beyond the range that normal farm management can deal with;
>
> [-0.5] indicating additional effort will be needed to control the pest problem which may affect the profitability of the land-use system, but which may otherwise be within the range of farmers' management options; and
>
> [-1] indicating the severity of the pest problem is such that it is probably beyond the means of farmers to control either economically or technically.

Landscape-level assessment: Overall, neither ASB nor anyone else has many answers for the practical questions regarding biodiversity function at the landscape scale. One obvious priority for further work is

to examine whether the risk of pest and diseases increases as biodiversity richness declines within these changing landscapes (Naylor and Ehrlich, 1997). Although not often mentioned prominently by national and regional policymakers, farmers in the humid tropics typically rank crop pests and diseases (including weeds) as their paramount resource management concern. With rare exceptions (collective action for pig hunting in Sumatra, locust control, synchrony in rice planting to reduce opportunities for rats), interventions beyond the plot/household scale seem rare. (See Swift et al. (2004) and Tomich et al. (2004) citations in Annex 2). (This paragraph draws heavily on the Tomich et al. article.)

2.2.3. Resource base and supporting services

2.2.3.1. Soils

(Contacts: M Swift (lead), C Palm, K Hairiah, D Bignell, J Alegre, F Agus, M Locatelli, A Ziegler)

Soils are essential for providing many of the services needed to maintain productivity, including nutrient cycling and hydrological functions, as well as regulating the fluxes of greenhouse gases to the atmosphere. The physical, chemical, and biological properties of soils determine their overall supporting service and are affected by deforestation and land use change. The role of soils and the interaction with above- and belowground biodiversity is a central theme to the sustainability of land-use systems in the tropics and is being investigated at several scales.

Plot-level methods: Thus far the soil resource and related ecosystem supporting services have been assessed only at the plot level. For each land use type soils were assessed directly in the field using standardized protocols (see Hairiah et al. (2005), listed in Annex 1). The *soil bulk density* in the different land use systems relative to that of the forest soil (BD/BDref) was used as an indicator for the status of the compaction of the soil. Soil compaction can impede root penetration and water infiltration, thereby affecting plant productivity, water runoff, soil water balance, and gaseous exchange, which influences plant growth and nutrient cycling, as well as regulation of atmospheric trace gases. Similarly, *soil organic carbon* was measured in the forest and different land use systems. Soil organic matter or soil carbon is an overall integrator of many soil parameters that relate to soil services and functions including the nutrient supplying capacity of the soil, the energy supply that drives soil biological activity, and soil aggregation. *Soil exposure* was assessed for the different land use types according to several parameters: soil cover ('low' was defined as having <75% of the soil surface covered by litter, leaf layers, or undergrowth); the number of months per year the soil is exposed to direct sunlight and rainfall; and the length of time between clearing events.

Plot-level data: Information was obtained in the field by direct measurements. If measurements were not available on bulk density or soil carbon from forests or land use systems of similar soil texture they were corrected using equations for predicting soil C or bulk density on soils of similar texture (Hairiah et al. (2005), listed in Annex 1).

Plot-level indicators: Soil bulk density, relative to that of the forest system, was used as an indicator of soil compaction; soil carbon saturation deficit (Palm et al. (2005) and Hairiah et al. (2005), listed in Annex 1) was used as an indicator of the amount of soil C lost in the different land use systems relative to that of the forest; and a soil cover index was developed to reflect both the percent of time that a soil is exposed to rain and sun and the length of the cycle before the land is cleared again.

Landscape-level methods, data, and indicators: The work by Ziegler et al. (2004) (see Annex 2) epitomizes what can be accomplished through informed scientific efforts to measure lateral flows. They provide evidence that unpaved roads produce as much sediment as agricultural land in an upper catchment in Northern Thailand, despite the fact that these roads occupy less than one tenth of the area occupied by agriculture. Bruijnzeel (2004) (see Annex 2) presents additional evidence of disproportionate erosion rates on (incompletely) compacted surfaces such as roads, paths, tracks, and around human settlements. Further stages of compaction may lead to runoff without much soil loss, but surface flows may pick up soil as soon as they pass over soil with a higher propensity to entrainment elsewhere. Although conversion of forests to agriculture is invariably accompanied by tracks, roads, and settlements, the focus of most researchers on the former with almost complete neglect of the latter suggests an inadvertent 'misreading' of landscape processes, at least in the case of soil transport and sedimentation.

2.2.3.2. Biological diversity

(Contacts: A Gillison (lead), V Kapos (lead), H de Foresta, R Aggangan, V Areskoug, C Hutacharern, A Rescia Perazzo, Z Tchoundjeu)

Although biological diversity is not necessarily an ecosystem service *per se*, as indicated above, it provides a reservoir of biota that can and do provide a regulatory service, for example in pest management. A reduction in this reservoir results in a corresponding loss in pest management efficiency. Considerable ecological debate surrounds the issue of whether biological diversity enhances ecosystem resilience and stability, although most empirical information suggests this is the case in tropical moist broadleaf forests. As a resource base on which many ecosystem services depends, biological diversity is a major focus of this assessment because of the unequaled levels of, and rates of loss of, biodiversity in tropical humid lowland forests. Apart from its cultural, aesthetic and spiritual values, natural biological diversity is vital for providing many of the local needs in terms of foods, medicines, cash and regulation of pests/diseases. Agrobiodiversity (in the broadest interpretation) also regulates pests/diseases; provides a diverse set of crops that reduces risk to climate/economic fluctuations and provides nutritional diversity. But, as noted in section 2.2.2.5. above, very little is known about these processes at the landscape level (see Swift et al. (2004), listed in Annex 2).

Plot- and landscape-level sampling methods: Efficient sampling of biota as representative subsets or surrogates for biodiversity presents a major challenge. Undersampling of the range distributions of key taxa severely restricts modeling their spatial distribution and can seriously mislead interpretation of results. Many animals that dwell in forests also range across different landscape mosaics that include many non-forest vegetation types. By sampling key taxa along a hierarchy of environmental gradients, the potential

for sampling range distributions is greatly enhanced (Gillison and Brewer, 1985; Wessels et al., 1998). For this reason the gradsect sampling method was used to locate sample plots. This approach also incorporates perceived land use intensity gradients. Within each regional gradsect, a series of 40 x 5 m transects (plots) was sampled using a standardized protocol (http://www.consecol.org/vol6/iss2/art3) for total vascular plant species, plant functional types (PFTs), vegetation structure, and a range of key site physical variables. An intensive multitaxon survey in Sumatra included sampling of birds, mammals and above- and belowground invertebrates as well as soil physicochemical variables and aboveground carbon (Gillison, 2000). In that survey, *belowground biota* were assessed in co-located plots in each land use type in a series of nested sampling plots according to both species and functional types including earthworms, ants and termites, which influence both soil porosity and nutrient relations; nematodes, which influence turnover of C and nutrients in their roles as root grazers; mycorrhizae and root-nodulating bacteria, which improve nutrient access; and overall microbial biomass (see Bignell et al. (2005), listed in Annex 1). The biophysical variables sampled using the standard protocol were implemented in 117 ASB sites in Cameroon, Indonesia, Thailand, Brazil, Peru and Mexico (Yucatan) and form the primary database for within and between region comparisons. They also formed focal points for co-located assessments of GHGs and carbon.

Plot-level indicators: The most significant indicators for certain faunal groups were plant species and PFTs (Gillison et al., 2000; Gillison et al., 2003; Jones et al., 2003). Highly significant correlations were also found between plant-based variables, nutrients, and soil physical variables, especially soil bulk density. Results from similar surveys in the Brazilian Amazon basin based on ASB methods (Gillison, 2002) show consistent trends suggesting robustness in indicator value within and between regions.

Biome- or ecoregion-level assessments of biological richness and endemism: Since these are being conducted by the MA global assessments, it remains to be seen how much value can added by ASB-MA repeating this work. To date, the current (and past) condition of biodiversity was assessed through the use of ecoregion maps prepared by the World Wildlife Fund-US (Olson et al., 2001). The observed phenomenon is loss of biologically diverse habitat, not biological diversity *per se*. See map of WWF ecoregions within tropical and subtropical moist broadleaf forest biome showing ASB-MA benchmark sites (http://www.asb.cgiar.org/gallery/ASB-MA_sites-Global 200-mosaics.ppt). However, using the same generic rapid sampling protocol, extraordinary levels of plant biodiversity richness have been found in Riau Province Sumatra as well as NE. India (http://www.cbmglobe.org). A global database currently held by CBM contains uniformly collected site data from more than 1600 sites worldwide including all ASB biodiversity sample sites. This database is currently being used to assess and compare biodiversity levels across more than 23 countries. The rapid survey protocol developed in association with ASB makes possible rapid assessment and comparison of data across all global scales and this is facilitated by the hierarchical nature of the variables sampled (from local species to generic PFTs and vegetation structure).

2.2.3.3. Ecological knowledge

(Contact: L Joshi)

See discussion above in section 1.2.3.3.

2.3. Tradeoffs among ecosystem services

(Contact: C Palm)

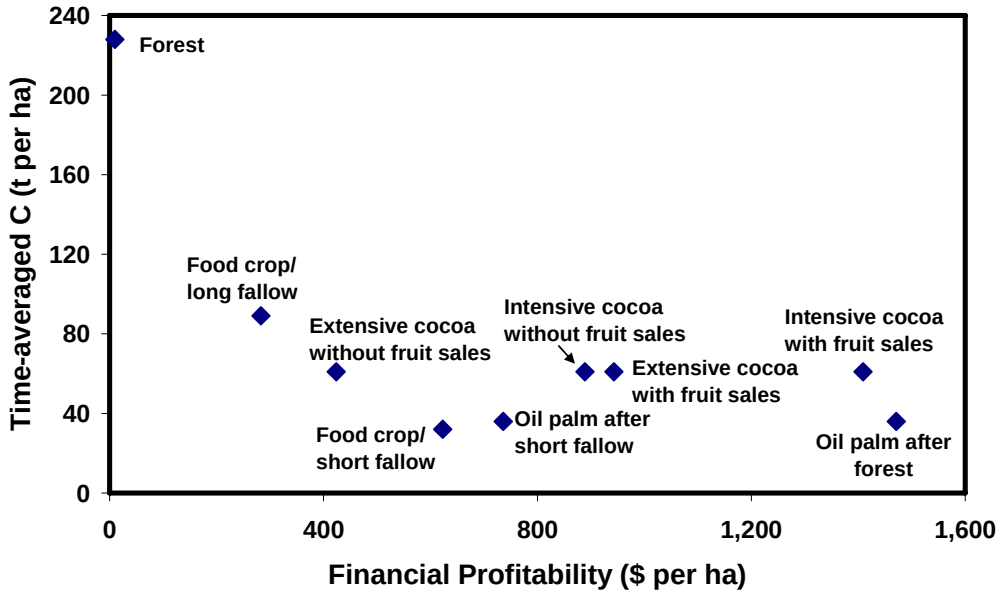
Analysis of conditions of the various categories of ecosystems services associated with the different land use systems at the ASB benchmark sites provides a trade-off matrix that examines the global environmental regulating services, local provisioning and regulating ecosystem services, and the supporting ecosystem services and the tradeoffs among them. It is a powerful tool for use by multiple stakeholders, often with conflicting interests, in analyzing and negotiating the outcome of certain land use changes. These trade-off matrices have been developed for the Brazilian, Cameroonian and Indonesian benchmark sites; matrices for Peru and Thailand are forthcoming (see Tables 1 to 3).

Deforestation and establishment of different land use systems result in inevitable losses of certain ecosystem services of global importance (biodiversity, carbon stocks, etc.) while resulting in the provision of other services (food, fiber, feed, etc.) for local livelihoods (and national economic development). The provision of goods is usually but not always at the expense of some ecosystem services. Some of the land use systems, particularly complex agroforestry systems, can maintain almost half of the carbon stocks and perhaps more than half of the biodiversity while also providing products and economic profitability. As examples, complex agroforestry systems provide food, including nutritionally diverse fruits; products sold for cash, including timber and fruits; and international commodity crops such as rubber, cacao and coffee. Yet these systems maintain 25-50% of the carbon of the natural forest; often contain levels of biodiversity similar to that of forests; maintain hydrological functions; and sustain many soil-supporting functions. These systems at current levels of production appear to be sustainable in terms of their provisioning and regulating services. Not all agroforestry or tree-based systems maintain carbon and biodiversity. As an example from Cameroon, most of the tree-based systems contain similar amounts of C but have drastically different levels of biodiversity. Intensification of food crop production systems, under current conditions of inadequate inputs to maintain production, however, lead to loss of many ecosystem functions, especially those that pertain to sustained production, nutrient cycling and pest and disease control and also result in the continued degradation of carbon sequestration and biodiversity.

Having standardized methodologies, co-located measurements, and a set of sites and land uses that represent the extremes of land use at the humid forest margins provided ASB with unique yet comparable datasets that have been be used to investigate the site specificity or generalities in the tradeoffs and synergies among services. The tradeoffs stated above are concerned with plot-level analyses and therefore assume that the ecosystems services come from the same plots at the same time. This assumption does not always hold, some of the provisioning services—such as food crops— can come from the same plots but at

different times in the cycle of the land use system, and therefore there may be temporary tradeoffs (increased food production decreased biodiversity) that are switched through the rotation time of the land use systems. As vegetation regrows during fallow and tree establishment phases there is less food production and increased biodiversity and carbon. Additionally if this is expanded to the landscape level, certain provisioning services are produced in parts of the landscape at the expense of carbon and biodiversity while carbon and biodiversity may be maintained in other land use systems on the landscape (see Figure 9). This type of temporal and spatial landscape analysis is a focus of the next phase of the assessment.

Figure 9. Financial profitability (US$ ha^{-1}) of the different land use systems in Cameroon versus the aboveground time-averaged carbon stocks (t C ha^{-1})



Source: Prepared by J. Gockowski and C. Palm; published in Tomich et al. (2005) (listed in Annex 1).

2.4. Human well-being, sustainable livelihoods, and poverty reduction

(Contacts: S Vosti (lead), C Diaw, F Zermoglio, J Gockowski, T Murray, Misa Kishi, T Tomich, D Timmer)

Specific land uses have been assessed for a number of indicators of smallholder concerns in Sumatra (Indonesia), Cameroon, Brazil, Peru, and Thailand; namely profitability (returns to labor and to land), labor requirements, and household food security (http://www.asb.cgiar.org/WG_socioecon.shtm) and also the effect of burning associated with land-use change on air quality (see section 2.2.2.2 above). These analyses will be extended and adapted to look more thoroughly at links between ecosystem services and human well-being.

The ASB-MA sub-global assessment is a cross-cutting assessment and there is great heterogeneity across ASB benchmark sites with respect to the following issues. Consequently, the following questions must be addressed separately for each unit before a synthesis is possible.

The CLAs hope to host a workshop for the ASB-MA team working on human well-being and ecosystem services (funding is being sought for this). The meeting would be designed to address the following questions and as a writing workshop on the issue of human well-being and ecosystem services:

What are the relevant components (see Figure 1 page 5 of MA Conceptual Framework summary) of human well-being in your study area?

What is the range of values reported for those components, in qualitative or quantitative units?

How does each ecosystem service you have studied lead to human benefit and well-being (i.e. what is the causal link, how strong is it, and to what factor is it sensitive)?

2.5. Tradeoffs between ecosystem services and human well-being

(Contact: T Tomich)

In the ASB matrix, natural forest and the land use systems that replace it are scored against different criteria reflecting the objectives of different interest groups. To enable results to be compared across sites, the systems specific to each site are grouped according to broad categories, ranging from agroforests to grasslands and pastures. The criteria may be fine-tuned for specific locations, but the matrix always comprises indicators for:

- Two major global environmental concerns: carbon storage and biodiversity.
- Agronomic sustainability, assessed according to a range of soil characteristics, including trends in nutrients and organic matter over time.
- Policy objectives: economic growth and employment opportunities.
- Smallholders' concerns: their workload, returns to their labor, food security for their family, and start-up costs of new systems or techniques.
- Policy and institutional barriers to adoption by smallholders, including the availability of credit, markets and improved technology.

Over the past eight years, ASB researchers have filled in this matrix for representative benchmark sites in Sumatra (Indonesia), Cameroon, the western Brazilian Amazon, and the Peruvian Amazon. Comparable results are forthcoming for Northern Thailand. Researchers working in Para State in the eastern Brazilian Amazon have compiled similar data and will be collaborating in the ASB-MA assessment. The social, political and economic factors at work at these sites vary greatly, as does their current resource endowment: from the densely populated lowlands of the Indonesian island of Sumatra, through a region of varying population density and access to markets south of Yaoundé in Cameroon, to the remote forests of Acre

State in the far west of the Brazilian Amazon, where settlement by small-scale farmers is relatively recent and forest is still plentiful. At each site, ASB researchers have evaluated land use systems both as currently practiced and in the alternative forms that could be possible through policy, institutional and technological innovations. A key question addressed was whether the intensification of land use through technological innovation could reduce both poverty and deforestation.

Occasionally it is possible to conserve tropical forests while reducing poverty, but more often these two objectives conflict (http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief5.pdf). The main point for policy makers is that, without tangible incentives linked to the supply of global environmental benefits, people will continue to cut down tropical rainforests. Results from ASB research at all the benchmark sites show that it is futile to attempt to conserve forests in developing countries without addressing the needs of poor local people. But how can the necessary incentives to conserve be put in place? Only a limited number of policy instruments have so far been tried and there is still much to learn about what does and does not work. Part of the answer lies in the developing countries themselves, which can take measures such as securing land tenure and use rights. But should these countries have to shoulder the entire financial burden of forest conservation when all face urgent development imperatives, such as educating and vaccinating rural children? The bottom line is that, if the international community wants the global benefits of rainforest preservation, it is going to have to stump up some of the costs.

2.6. Ecosystem resilience/thresholds (temporal and spatial)

(Contact: C Palm)

The ASB-MA team will attempt to address the following questions as part of the assessment work in 2006/7.

Were any critical thresholds in ecosystem service and human well-being identified? What was your definition of thresholds at the sub-global scale? Summarize the thresholds found. What drivers are more likely to influence thresholds?

2.7. Conclusions on conditions and trends

(Contact: C Palm and T Tomich)

The ASB-MA team will attempt to address the following questions as part of the assessment work in 2005.

What are your major conclusions for conditions and trends (ecosystem service by service) (include appropriate maps, tables if desired)? Use diagrams to show trends in conditions (e.g., increasing, decreasing, constant) by services, and uncertainty. What are the most important drivers for each ecosystem service?

2.7.1. Lessons learned concerning the process, methods, tools or approach

(Contact: C Palm)

2.7.1.1. Is there adequate information available on condition and trends? Where are the biggest data gaps?

Local ASB teams have been able to make reasonable assessments of current conditions in many ecosystem services from direct field measurements. Trends in conditions can be estimated when the data from the land-use intensity gradients is used in conjunction with changes in land use obtained by remote sensing and aerial photography (as was done for the Indonesia and Cameroon benchmark areas). A challenge will be extrapolation of this to assess conditions of services (such as soil parameters, nutrient balances, and pests and diseases at coarser scales) because of difficulties of distinguishing the various tree-based land use types in the humid tropics using remotely sensed data.

2.7.1.2. How useful was the MA concept of ecosystem services *in assessing the state of ecosystems? What are your suggestions on additional methods for assessing state of ecosystems?*

For ASB, distinguishing between provisioning services and regulating services was extremely important, particularly in areas such as the humid forest margins where provisioning services often (though not always) come at the expense of some of the regulating services. Tradeoffs become apparent readily in this analysis. The issue of where the services are provided and where they are used/appreciated is also important for analyzing the local versus global issues associated with both the provisioning and regulating services.

2.7.2. Heterogeneity of conditions and trends at the tropical forest margins

(Contact: C Palm)

Not only does the condition of the ecosystem services provided by the tropical forest biome vary dramatically among the sites in which the assessment is conducted but they also vary within each of the country sites (see Table 4). This heterogeneity reflects not only the irregular pattern of deforestation and land use change at the forest margins but also the importance of the scale at which the assessment is

conducted. Imagine the different conclusions regarding the provision of marketable timber, the climate regulation service of carbon sequestration, and the ecosystem services dependent on biodiversity that would be made if the Tropical Forest Margin Assessment had only been conducted at the sites in the Yaounde, Cameroon; and Lampung, Sumatra, Indonesia, where there has been considerable loss of forest cover and the current land-use systems focus on annual cropping; or only at the sites in Acre, Brazil; and Ebolowa, Cameroon, where forest it still the predominant land-use cover! This example stresses the importance of scale in designing, conducting, and reporting an assessment. To be representative, the area in which an assessment is conducted must attempt to include the range of conditions of the ecosystems and their services.

Table 4. Condition of ecosystems services at the tropical forest margins depending on the location at which the services are assessed.

COUNTRY	Plant biodiversity	Soil nutrients	Carbon sequestration	Fresh water	Flood protection	Food	Fuelwood
Brazil							
Acre	4	4	5	5	5	5	5
Rondonia	2	3.5	3	5	5	5	4
Cameroon							
Ebolowa	5	5	4	5	5	5	4
Yaounde	3	4	3	5	5	5	3
Indonesia							
Jambi	4	4	4	5	?	5	3
Lampung	1	2	2	5	?	5	1

Note: “5” approximates the level of natural forests; “1” would be considered highly depleted or degraded.

Part III. Ecosystem Dynamics

3.1. Driving forces of land use and cover change

(Contacts: H Geist (lead), M van Noordwijk (lead), L Lebel, J Valentim, A Gillison, C Legg, A Salazar, D Thomas, T Tomich, K Sebastian, J Tonye, M Locatelli, D White, D Carr, H Weyerhaeuser)

3.1.1. How was 'driver' defined in your assessment?

The definition used by ASB-MA is consistent with the definition in the MA Conceptual Framework.

3.1.1.1. Did you find the distinction between direct and indirect drivers useful?

Following Geist and Lambin (2001, 2002) we have used a similar distinction between 'proximate drivers' and underlying 'driving forces'. This distinction is essential analytically and is useful in conveying information to policymakers (see for example ASB Policybrief No.6 (http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief6.pdf). However, it has not been a useful distinction in local-user consultations.

3.1.2. What methodologies were used to assess drivers?

Geist and Lambin (2001, 2002) did a meta-analytical study of 153 sub-national deforestation cases, based on the framework of the IGBP-IHDP's (International Geosphere-Biosphere Programme/International Human Dimensions Programme on Global Environmental Change) Land-Use and Land-Cover Change (LUCC) project using a limited set of five candidate underlying driving forces (or 'indirect' drivers), and a limited set of proximate causes of land change (or 'direct' drivers). Proximate (or direct) causes constitute human activities or immediate actions that originate from intended land use and directly affect land cover. They involve a physical action on land cover such as wood extraction, agricultural expansion, or infrastructure extension. Underlying (or ultimate or primary or indirect or root) causes are fundamental forces that underpin the more proximate causes of land-cover change. They operate more diffusely (i.e., from a distance), often by altering one or more proximate causes. Underlying causes are formed by a complex of social, political, economic, demographic, technological, cultural, and biophysical variables that constitute initial conditions in the human-environment relations and are structural (or systemic) in nature. Proximate causes generally operate at the local level (individual farms, households, or communities). By contrast, underlying causes may originate from the regional (districts, provinces or country) or even global levels, with complex interplays between levels of organization. Underlying causes are often exogenous to the local communities managing the land and are thus uncontrollable by these communities. Only some local-scale factors are endogenous to decision-makers. They coded the frequency of occurrence of each causative factor and its interlinkages, as well as the mode of causation (i.e., single factor causation, chain-logical connection, concomitant occurrence). Geist and Lambin (2001, 2002) checked for several biases, including regional distribution of sub-national cases and author bias. They took for given that the causes

as reported by case-study authors in international, peer-reviewed journals (only-ISI covered articles were taken) do reveal the actual causes of land change in the regional reported. They used the information on causative factors to improve our understanding of how land-use decisions directly affecting land cover are made, and to provide an empirical foundation for land-use change modeling and scenario development.

3.1.3. Direct and indirect drivers

3.1.3.1. What are the main direct and indirect drivers? (list 3-5 most important)

Direct: agriculture, infrastructure, wood. Indirect: economic, institutions, technology, culture, demography. See ASB *Policybrief* 6 (http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief6.pdf).

3.1.3.2. Main findings on direct and indirect drivers

No single or key drivers are at work. Rather, there are causal synergies between factors or factor groups that show distinct regional variations and are filtered by mediating factors (e.g., user groups having distinct chances of resource access). As examples, in all regions of the humid tropics, deforestation is primarily the result of a combination of (commercial) wood extraction, (permanent) cultivation, livestock development, and the extension of overland transport infrastructure. However, many regional nuances are found to this general pattern. Deforestation driven by swidden agriculture is more widespread in upland and foothill zones of Southeast Asia than in other regions. Road construction by the state followed by colonizing migrant settlers, who in turn practice slash-and-burn agriculture, is most frequent in lowland areas of Latin America, and there, largely in the Amazon Basin. Pasture creation for cattle ranching is causing deforestation almost exclusively in the humid lowland regions of mainland South America. The spontaneous expansion of smallholder agriculture and fuel-wood extraction for domestic uses are important causes of deforestation in Africa. These regional differences mostly come from varying mixes of economic, institutional, technological, cultural, and demographic factors underlying the direct causes of deforestation.

As for policy intervention, it will be important to evaluate all the consequences of turning around certain drivers, as some of the underlying causes of, for example, deforestation (such as economic development and technological change) cannot be attenuated without negatively affecting the potential to improve the well-being of the population living in forest environments. Rather than being suppressed, these forces should be channeled toward a more sustainable use of environmental resources.

The findings of Geist and Lambin (2001, 2002), together with studies of driving forces at specific ASB benchmark sites are summarized in ASB *Policybrief* No. 6, Forces Driving Tropical Deforestation (http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief6.pdf). These findings are presented in greater detail in a chapter by Tomich et al. (2005) (listed in Annex 1).

3.1.3.3. Driving forces in Brazil: macroeconomics, road building and inter-regional innovation in agriculture

Logging, cropping and ranching are often identified as the proximate causes of deforestation in the Brazilian Amazon. However, the deforestation process in the Amazon is driven by multiple, interacting, underlying causes. Understanding deforestation in the Brazilian Amazon requires consideration of local, regional and national processes, and how these relationships interact and evolve over time. Transport costs have a fundamental impact on the profitability of agricultural options in the Amazon and, hence, on land values. The Brazilian government's plan to pave approximately 6,000 kilometers of highways cutting through the core of the Amazon is predicted to lead to an additional deforestation of 160,000 to 240,000 square kilometers over the next two to three decades. Further, since agricultural activities throughout Brazil are competing for labor, capital and land, the relative speed of innovation in different sectors and regions will matter. If innovation in the livestock sector *outside* the Amazon cannot maintain the pace of innovation in annual crops such as soy in those regions, a surge in deforestation could result as livestock production is displaced into the Amazon. ASB research highlights how productivity improvements, whether driven by economy-wide policies or by public investment in agricultural research, have a substantial impact on both agricultural incomes and future deforestation in the Brazilian Amazon. At the macro scale, ASB researchers have demonstrated that exchange rates have an important impact on deforestation. This research indicated that a 40% real devaluation of the Brazilian real against the US dollar would lead to increases in deforestation of up to 6% in the short term and 20% in the long term, with an increase in logging of 16-20%; these simulation results are in line with recent events. The process works like this: when a devaluation causes regions with better international market access to switch to export crops, production of livestock in the Amazon grows to meet domestic demand for beef.

3.1.3.4. Driving forces in Cameroon: shocks and trends

Cameroon is the only ASB case-study country in which shifting cultivation of food crops for subsistence appears as a dominant proximate cause of deforestation. Yet even here, macroeconomic policies and economic trends are intimately linked to the direction of change. Cameroon provides a textbook case of how economic signals alter the attractiveness of different cropping systems to small-scale farmers, with major implications for deforestation rates. From 1977 to 1985, Cameroon enjoyed an export-led boom based on petroleum, coffee and cocoa. This boom was followed by an abrupt decline in the second half of the 1980s, as the country's oil ran out and the international prices of all three of its main export commodities slumped. In 1989, shrinking export revenues forced the government to stop subsidizing agricultural inputs and to halve the prices of coffee and cocoa offered to farmers. These measures were followed, in the early 1990s, by draconian cuts in public-sector employment and wages. Finally, Cameroon's currency was devalued in 1994. These economic shocks had a dramatic effect on Cameroon's rural areas. Analysis of satellite images shows that, in 1986-96, annual deforestation doubled over its 1973-86 level in areas close to the capital city and quadruped in more remote, thickly forested areas. As the crisis deepened, rural-urban migration first slowed then went into reverse, as impoverished city

dwellers returned to the countryside to take up farming. A sample of rural villages from the humid forest zone showed that the population of these villages grew by only 1.6% in the 1976-87 period, but by a massive 24% in 1987-97. Most of the 'returnees' put their efforts into growing foodcrops, first to ensure family food security and then to sell on local markets. Existing farmers also grew more foodcrops, while maintaining or expanding their area in treecrops in the hope that high prices would return. The expansion of foodcrops, which was more pronounced in remote, thickly forested areas, greatly accelerated deforestation. Four other factors in the larger economy drove the expansion of food cropping: food imports declined during the crisis; more flexibility in the gender division of labor, in response to the crisis, allowed an increase in labor inputs; the phasing out of subsidies for inputs forced farmers to cultivate larger areas to maintain production; and logging, which clears the way for food and cash crops, accelerated following the 1994 currency devaluation. The Cameroon case reveals how some of the effects of macroeconomic forces are expressed through the responses of thousands of small-scale farmers. But it also shows how these forces can affect the *pace* and *location* of deforestation, rather than whether or not it happens at all. In other words, changes in macroeconomic conditions may merely replace one proximate cause of deforestation by another.

3.1.3.5. Driving forces in Indonesia: jostling for profits

Pressures on the forest exerted by smallholders may be temporarily reduced in times of rapid economic growth, when poor rural people migrate to the cities. But such growth also contributes to the wealth that enables urban capitalists to invest in agriculture – adding pressure from a growing class of absentee commercial farmers or plantation owners. In Indonesia, decades of economic growth, exploitation of natural resource wealth and subsidized loans culminated in a boom during the early to mid-1990s have created a powerful class of large-scale land operators whose interests clashed with those of smallholders. The 1997 collapse of Indonesia's currency made conversion of forest land to production of export treecrops such as oil palm, rubber, cocoa and coffee even more attractive. ASB's case studies on the Indonesian island of Sumatra revealed a mix of large- and small-scale producers jostling for land. Successive waves of migrants have penetrated further and further into the island in a process of migration from neighboring Java that has taken place over many decades. Moreover, many native Sumatran smallholders were displaced by the large-scale plantations, timber estates and concessions established by public or private projects, particularly in the 1970s and 1980s. The mixture of these different groups of land users, migrant and native, large-scale and small, has proved highly combustible, often leading to violence—as 'squatters' are driven off land they may have farmed for generations—and to the burning of plantations in revenge for such land grabs. In such situations, land tenure insecurity can become an important factor in deforestation. Planting treecrops is a recognized way of claiming land in Indonesia, and tenure claims contribute to the extensive nature of smallholder farming. The appropriation of large tracts of land for public or private projects fuels smallholders' perceptions of tenure insecurity. In this way, the expectation of new projects can accelerate forest conversion as a pre-emptive strategy for retaining local control of the land. Added to the complex set of macroeconomic forces in any given region are a host of institutional, technological and other policy-related factors that combine with broad social and

economic trends to affect deforestation rates. This category includes regional land use plans and development programmes, colonization schemes, agricultural subsidies and land tenure problems. The latter is particularly important when land becomes scarce, as in the Sumatran case.

3.1.3.6. For each driver, specify whether it is fast or slow. How would you rank the relative importance of the individual drivers (number 1 to be the most important)?

[**1**] Resource scarcity causing a pressure of production on resources, e.g., (*slow variables*) domestic life cycles leading to changes in labor availability, or (*fast variables*) decrease in land availability due to encroachment by other land uses, i.e., tragedy of enclosure; [**2**] Changing opportunities created by markets, e.g., (*slow variables*) improvement in accessibility through road construction, or (*fast variables*) new technologies for intensification of resource use; [**3**] Outside policy interventions, e.g., (*slow variables*) perverse subsidies, policy-induced price distortions and fiscal incentives, or (*fast variables*) rapid policy changes such as devaluation of national currency; [**4**] Loss of adaptive capacity, increased vulnerability, e.g., (*slow variables*) breakdown of informal social security networks, or (*fast variables*) risks associated with natural hazards (e.g., leading to a crop failure); [**5**] Changes in social organization, in resource access, and in attitudes, e.g., (*slow variables*) changes in institutions governing the access to resources by different land managers (e.g., shift from communal to private rights, tenure, holdings and titles), or (*fast variables*) loss of entitlements to environmental resources (e.g., through expropriation for large dams) leading to an ecological marginalization of poor people.

3.1.4. Lessons learned concerning the process, methods, tools or approach

Addressing drivers is as important as identifying feedback mechanisms between drivers, initial conditions (i.e., the land use and environmental history), and the process of ecosystem change itself. (However, as mentioned above, it has not been a useful to distinguish between direct and indirect drivers in local user consultations.) Positive (or amplifying) feedbacks speed up the rate of ecosystem change and easily lead to a pathway of degradation, while negative (or mitigating) feedbacks slow down ecosystem change and open a pathway towards restoration or innovation. Policies should focus on the feedback mechanisms built into pathways of ecosystem change (e.g., deforestation), with an aim of weakening positive feedbacks and strengthening negative feedbacks.

3.2. Scenarios

(Contacts: SJ Velarde (lead); W Mala (lead), L Lebel (lead), K Sebastian, E Douglas, S Wood, R Prieto, M Lopez, J Ugarte, P Thongbai, P Preechapanya, D Pipattwattanakul, K Manassrisuksi, D Huasai, P Promburom, M Bentes-Gama, R de Oliveira Figueiredo, S Rojas, J Tonye, G Na-ah Nyambi, F Agus, A Bustanul, R Cabahug, R Dimla, M Ngobo, S Rao, M Zurek, E Bennett)

3.2.1. What was the scope and range of the scenarios explored in your assessment?

A large number of our partners are extremely interested in, and committed to, the scenarios portion of the assessment. But if this is to be realized, this is an area in which further training will be needed, especially at the regional and national level (see section 3.2.3 below). As a follow up to ASB's global training on scenarios (see 3.2.4 below), facilitators conducted, in 2005, local scenarios exercises in ASB benchmark sites in Peru, Brazil and Thailand, involving a variety of clients, including children and indigenous groups. The final reports will be posted on-line as they become available at http://www.asb.cgiar.org/ma/scenarios.

Before the global training, ASB partners had little experience with scenarios, with the exception of the five cases listed immediately below. These five scenarios exercises have been developed by ASB partners and aim to analyze natural resource management options with a focus on biodiversity, hydrological functions and forest cover. In general, major exogenous uncertainties for these scenarios exercises are international commodity markets (e.g., for cocoa, oil palm, timber, and other tropical forest products) and global environmental change and responses; major endogenous uncertainties are human behavior, adoption of new technologies, and innovations in institutional arrangements.

Cameroon landscape scenarios at community scale. Our colleagues, William Mala and Sandra J. Velarde, posted answers to the scenarios template questions for the ASB experience in Cameroon: http://www.asb.cgiar.org/ma/scenarios/Scenarios-Cameroon.doc. The villagers actively participated in the formulation of scenarios, using ecological historic transects, participatory social and agroecological maps, and creating graphics of the landscape futures across time. These are forms of Participatory Rural Appraisal which have been widely used in developing countries. The scenarios were constructed based on the historical and ecological matrix, the history of rural settlement and the status of well-being in relation to resource management strategies. The time scales were, 1970, 2000 and 2030. The scenarios create a platform for negotiation in order to articulate a shared vision of the future and to identify an approach to address it. In this particular case, the results were inconsistent with the findings of scientific research on the investment strategies of local farmers. This raises the question of how different forms of communication should be evaluated in the process of scenario development.

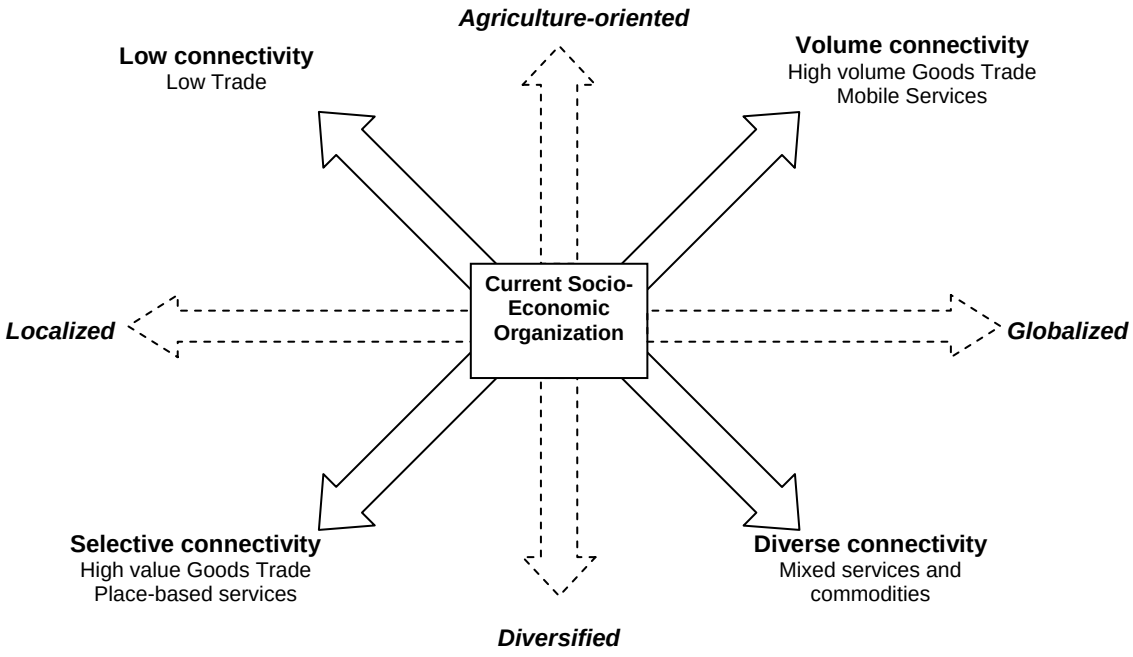
Brazil regional and local scale scenarios. At the regional level, an economic model was used to test the effects of devaluation on a landscape/forest area in Brazil. The published results were mainly targeted at the regional government, as well as the international and national scientific community. Results and methodologies used are detailed in IFPRI report 129 (http://www.ifpri.org/pubs/abstract/129/rr129.pdf). In the western Amazon of Brazil, data obtained at the local level were used to inform farm-level 'bioeconomic models' in which the effects of different mixes of technological innovations were tested at different time horizons. The results were communicated to policy makers through the Brazilian Enterprise for Agriculture and Livestock Research (Embrapa), a Brazilian government agency which is one of the

partners in the ASB consortium. The results and methodologies are documented in IFPRI report 130 (http://www.ifpri.org/pubs/abstract/130/rr130.pdf).

Montane Southeast Asia landscape scenarios at landscape scale and river basin scale. As a sub-project of the ASB BNPP project (see section 2.2.2.3), our colleague Louis Lebel has led a team at Chiang Mai University in formulating a set of four contrasting scenarios of socio-economic development that, in turn, frame a more detailed set of assumptions about changes in land use with an emphasis on factors likely to affect hydrology. Each scenario consists of (1) a storyline describing the development process in broad terms; (2) a set of explicit rules for evolving landscapes under each scenario; and (3) a set of evolved land-use and land-cover maps for the Ping River Basin, for Mae Chaem, and for the Mekong River Basin under each of these scenarios at 10-year intervals from 2000 through 2050. This work will be completed soon and is described in detail in BNPP Activity 2 implementation protocol: (http://www.asb.cgiar.org/BNPP/phase2/protocols/Activity%202%20Implementation%20Protocol_v6.0.doc). The results will be part of a regional and national strategy to translate them for regional "policy shapers" and policymakers.

The Mae Chaem scenarios are arranged along two contrasting axes (see Figure 10). The first captures the character of linkages to outside the region (globalization-localization). The second examines the sectoral composition of economic development (agricultural–diversified). Taken together these two axes were seen as determining a third composite axis of "connectivity" (or cluster of processes), shown in solid arrows, that captures an essential cluster of features in each of the quadrants, and that was then developed into each of the contrasting scenarios.

Figure 10. Axes of uncertainty – quadrants approach



Structural or soft models and event sequence diagrams were used in the Mae Chaem scenarios to help clarify the logical assumptions behind each of the stories (see Figure 11). These were prepared before the text was written and then partly revised and adjusted as the storylines themselves became richer and more specific. This scenario exercise produced spatially explicit maps of land-use and cover. Producing these maps required rules or equations for manipulating land-cover classes.

The set of scenarios for Thailand were planned from the outset as nested with scenario exercises planned carried out at two levels: Mekong Region and Northern Thailand. The geographical scope of the scenarios in each case was set one level larger than the focus area for assessment and simulation of landscape trajectories (see Figure 12). This was considered extremely important in this case because the major assumptions were about connectedness (trade, investment, information, etc.) and the structure of the regional economy. At the finest level of analysis, a rural area (Mae Chaem watershed) has been largely completed and an urbanizing area (greater Chiang Mai) began in early 2004.

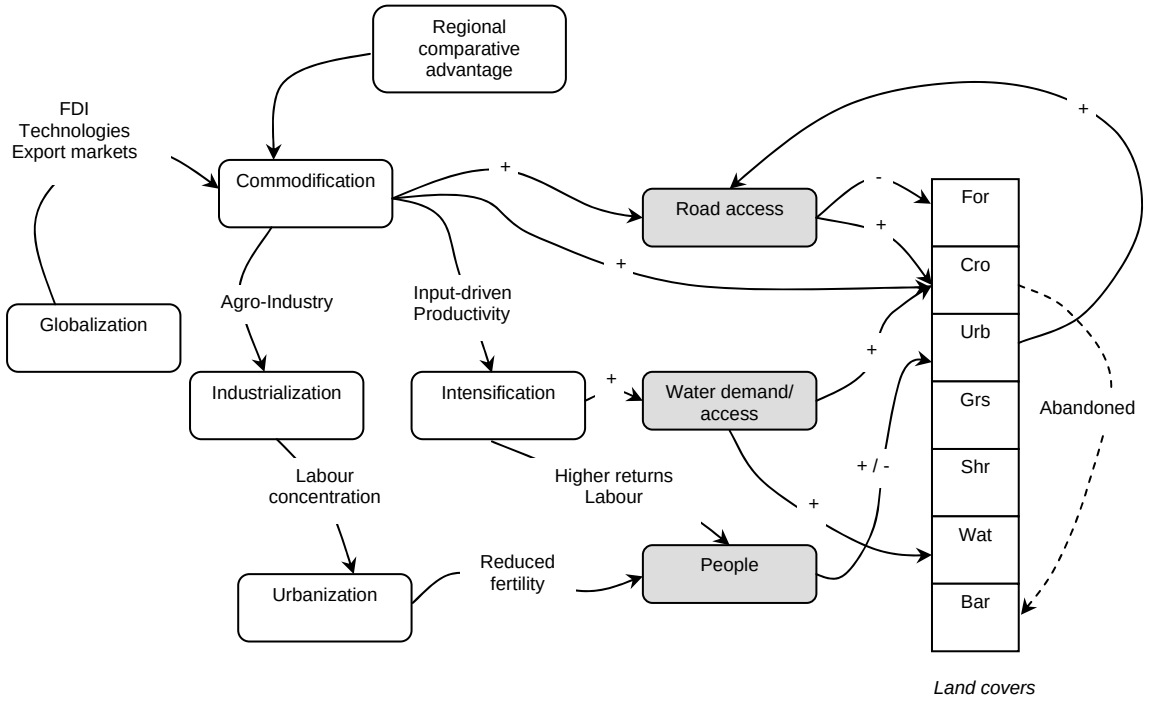
An advantage, but also source of complexity, is that explicit nesting allowed some preliminary consideration of the plausibility of particular scenarios unfolding at one scale given changes at another. When these mixtures were cross-tabulated we found we could eliminate many “discordant” combinations as instable and unlikely to persist. For example, it is hard for Northern Thailand to pursue a strongly locally-oriented development trajectory while the wider region unfolds in a highly globalized and inter-connected manner.

This approach of examining “discordance” among scenarios created at different levels is pragmatic: it is still a long way from allowing dynamic feedback between scenarios at various levels.

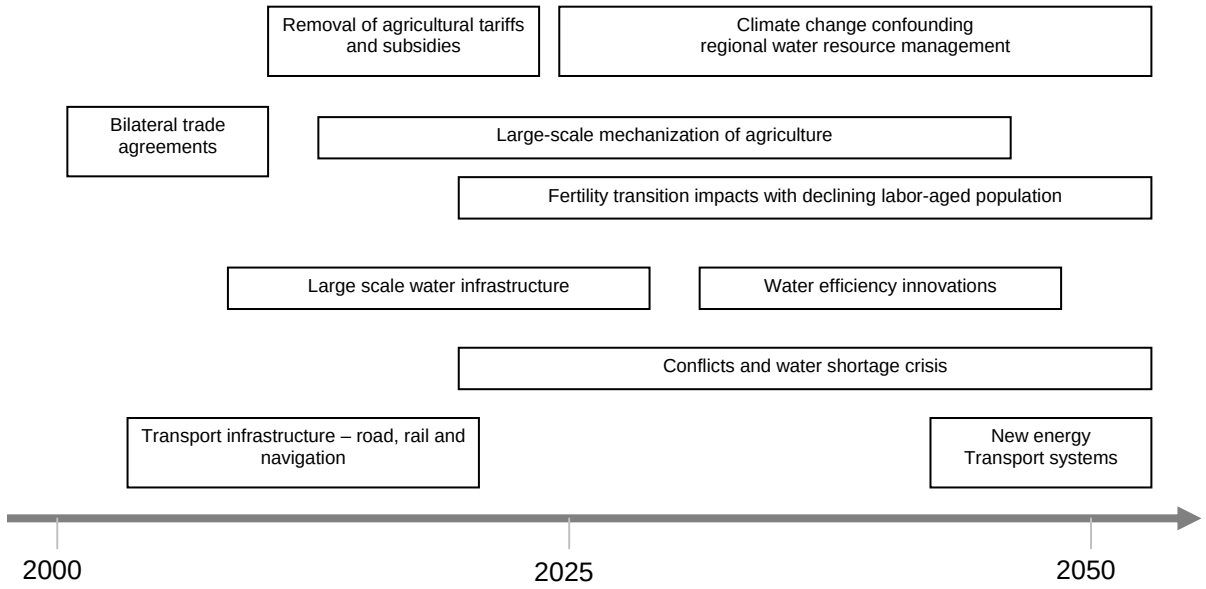
Figure 11. The use of soft models as an intermediate step in the Mae Chaem scenario exercise

FOOD BOWL SCENARIO

A. Underlying mechanisms

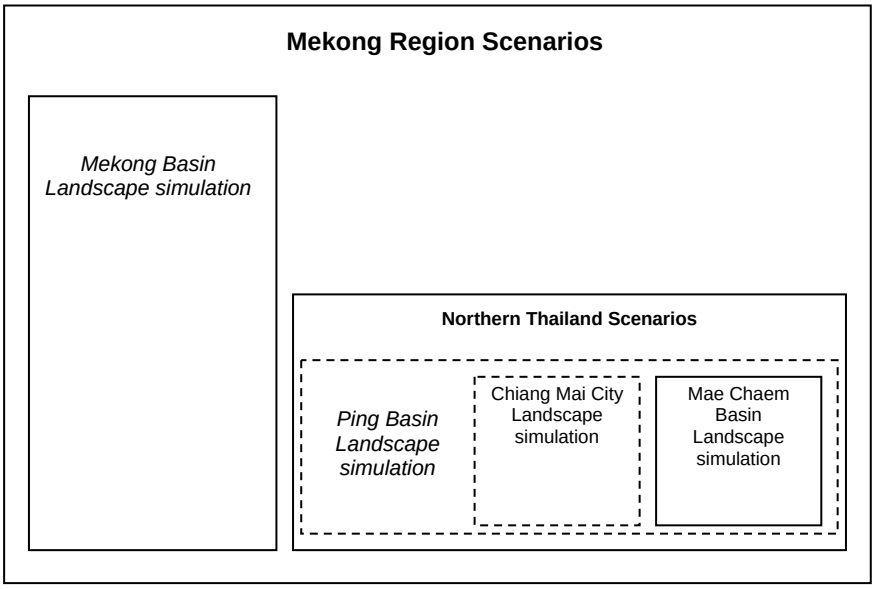


B. Pathway



To handle spatial heterogeneity, we used baseline maps of biophysical or basic demographic features to help understand how scenarios unfold differently in different locales. The resolution of the "drivers" and of "outcomes" may differ. The simulated landscapes in the Mekong Region scale were based on 10 x 10 km gridded input data and processes at this and higher aggregated scales, whereas the Mae Chaem Basin simulations used a 1 x 1 km grid as the basis for land-use evolution. The later landscape will probably be modeled hydrologically on the finer, 30 x 30 m, digital elevation map cells.

Figure 12. Nested structure of scenario exercises and corresponding landscape simulations for the tropical forest margins set in Northern Thailand – Mekong Region



Pantropic land-cover change scenarios. Also as part of the ASB BNPP project (section 2.2.2.3), Kate Sebastian and Stan Wood of IFPRI and Ellen Douglas and Charles Vorosmarty of UNH developed scenarios for change in the humid tropical forests pantropically (http://www.asb.cgiar.org/BNPP/phase2/ifpri/pan_trop_definitions_13jul2003.gif). One (retrospective) scenario was determined by the change in area of forest from pre-industrial forest cover (that is potential forest cover) to current times (1992). The pre-industrial land cover is based on the World Wildlife Fund's "Ecoregions of the World" map and contemporary land cover was defined using a combination of the 1992/93 IGBP, the IFPRI Seasonal Agricultural Extent land cover classification systems and pasture\land as defined by the Center for Sustainability and the Global Environment (SAGE). In addition future trends in forest cover will be assessed according to two projections: 1) by mapping forests outside protected areas and assuming they were most likely to be deforested, and 2) by a business-as-usual deforestation rate until the year 2025. Scenarios were developed to analyse the implications of biodiversity loss on hydrological functions. A constant 'back and forth' with one of the World Bank experts helped to delineate the focus of

the results in order to effectively inform policy makers of the information they need. At the end of the project[1], the results were presented in a one-day policy seminar at the World Bank. This work will be complete soon and is described in detail in: BNPP Activity 1 Implementation Protocol (http://www.asb.cgiar.org/BNPP/phase2/protocols/impl_prot_act1_v2.0.doc).

3.2.2. Lessons anticipated concerning the process, methods, tools or approach

Some of the results of land use trajectories and drivers obtained at some of the ASB sites may be valuable for providing scenarios for other sites. However, we believe it will difficult to develop a uniform set of scenarios across ASB benchmark sites. But a site-by-site, country-by-country approach may reveal commonalities and differences, thereby enriching the scenarios from different experiences and viewpoints.

3.2.3. How are you interacting with the MA global scenarios work?

There is high demand for training in formulation and use of scenarios among ASB-MA participants, including many scientists from developing countries. The MA global scenarios team supported the ASB-MA Global training for facilitators in Chiang Mai, Thailand, November 2004. Funding was provided by the ICRAF-SII project. One good prospect is the possibility of an Amazon scenarios workshop at some time in the future, and members of the MA global scenarios team have been enthusiastic about this. Since the limited ASB experience with scenarios (listed above in section 3.2.1) is largely with expertly designed scenarios exercises and few participatory exercises, there is a particular need for training and experience at the regional and national level in participatory development and use of scenarios, and an opportunity to link this with the ongoing strategic stakeholder analyses and user needs assessments (section 1.3.5).

3.2.4. Scenarios capacity building

As noted above, ASB partners have limited experience with participatory formulation and use of scenarios. To fill this gap, a workshop was conducted in November 2004 in Chiang Mai, Thailand, to train ASB facilitators (Rao and Velarde, 2005). Planned follow up to the workshop includes local scenarios activities at ASB sites. So far, six local scenarios exercises have taken place: four in Peru, one in Brazil and one in Thailand. The scenarios exercise in Cameroon, a 'virtual' on-line event to compare results and distill lessons learned, and a toolkit for conducting scenarios are planned for 2006.

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[1] Functional Values of Biodiversity project, Phase II, 2003, from the World Bank Netherlands Partnership Programme and the Alternatives to Slash-and-Burn programme, IFPRI, University of Washington and University of New Hampshire. The results will be used as input for the conditions and trends sections of the Tropical Forest Margins assessment. Full documentation of this project is available at: http://www.asb.cgiar.org/BNPP/phase2/bnpp_phase2_general.htm

3.3. Responses

(Contacts: M de los Angeles (lead), D Murdiyarso, D White, W Mala, S Vosti, D Timmer, T Tomich, SJ Velarde)

The forest margins of the humid tropics tend to be relatively isolated and at the margins of formal administrative influence. 'Illegal' activity around resource access and use tends to be common. (For example, some of the ASB benchmark sites historically have been centers of narcotic production; some still are). Many different kinds of actors 'respond' to opportunities at the forest margins; often there are conflicting interests among these actors. The bulk of responses to driving forces and also to changes in ecosystem services are private, spatially-dispersed, and uncoordinated by central administrative authorities.

Particularly in this context, attempts to impose coordinated responses (e.g., government interventions) will face difficult prospects and risk perverse results if these interventions ignore the interests "on the ground", producing a vast number of private responses that dominate decisions about land use and land cover change.

Moreover, understanding *lack* of government response is as important as assessing coordinated response options. Lack of government response in part reflects the distinctive isolation mentioned above (i.e., results from lack of information). However, from the point of view of environmental or sustainable development objectives, the common lack of response or apparently misguided responses result from the power of vested interests who have a stake in particular patterns of resource use (e.g., logging, ranching, large-scale plantations). At the same time, accountability and public administrative capacity tends to be relatively weak. Thus, assessment of responses and response options needs to include both the (imbalanced) political economy and (weak) organizational capacity of public institutions.

As noted above (section 1.1.2), ASB addresses the intersection of two classes of problem: tropical deforestation and rural poverty. There are a number of options for coordinated responses to each of these problems taken alone (e.g., the whole field of rural development; protected areas policy). But, as also shown above (section 2.5), the domain of the ASB-MA assessment is characterized by tradeoffs between development opportunities and environmental concerns. **Responses to managing these tradeoffs will be the focus of the ASB-MA work on this topic in 2006.**

ASB research (particularly in Indonesia and Cameroon) has revealed the feasibility of a 'middle path' of development involving smallholder agroforests and community forest management for timber and other products (see Tomich et al. (2005), listed in Annex 1). Such a path *could* deliver an attractive balance between environmental benefits and equitable economic growth. A number of site-specific alternatives to slash-and-burn agriculture, including sustainable forest management, smallholder agroforestry, improved pastures, and *Imperata cylindrica* grassland reclamation, are assessed in depth in *Slash and Burn: the Search for Alternatives* (see Annex 1). 'Could' is the operative word, however, since whether or not this balance is struck in practice will depend on the ability of these countries to deliver the necessary policy and

institutional innovations. See ASB *Policybriefs* 2, 3, 5:
http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief2.pdf

http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief3.pdf

http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief5.pdf

Trends of decentralizing government function from national to regional authorities have the potential to improve or worsen natural resources management. Although local people know best the importance of good stewardship, equitable governance over natural resources is not assured. Questions remain as to how to effectively assure the use of natural resources by the larger public. Improved information and communication amongst stakeholders—local, national and international—may be the key to fostering local capacities for more sustainable natural resource management; and communication for a facilitated stakeholder involvement and resolution. Peru, for example, has experience with round-table discussions with diverse actors to develop the forestry laws including timber industries, green NGOs, indigenous groups, government officials, and academicians.

Among the range of possible coordinated responses that will be assessed in 2006, areas of particular interest are:

- **Technological change** to increase agricultural productivity and thereby 'deflect' development from natural forests. This was the premise on which ASB was founded and which can be linked to recommendations agreed at the 1992 Rio Earth Summit (*Agenda 21* Chapter 11 on Combating Deforestation).
- **Land and tree tenure reform**; property and resource access rights.
- **Incentive schemes for environmental services** that target benefits to the rural poor, including, but not limited to, "environmental service payments" (see "Rewarding Upland Poor for Environmental Services" on: http://www.worldagroforestry.org/sea/Networks/RUPES).
- **Negotiation support systems** (van Noordwijk et al., 2001) and other social and political approaches that can accelerate learning, adaptation, and discovery of feasible options to "win more and lose less" (see the "Rainforest Challenge" pre-proposal on: http://www.asb.cgiar.org/RC.shtm).
- **Landscape restoration** to revive habitats and restore ecosystem functions while reducing poverty by creating valuable assets for the rural poor (also see the "Rainforest Challenge" pre-proposal on: http://www.asb.cgiar.org/RC.shtm).

Responses were also addressed during the various user-needs consultations (section 1.3.5). A preliminary draft summary of those assessment questions is included in Annex 9. Final decisions on specific assessment questions regarding responses has been deferred to 2006, pending completion of assessment of conditions and trends and scenarios training.

Part IV. Looking ahead (to 2006 and beyond)

(Contacts: T Tomich, C Palm, SJ Velarde, D Timmer)

4.1. Evaluation and validation

The ASB-MA team completed a pilot assessment year in 2003 and continued with the assessment through 2004 and into 2005. It is therefore unlikely that it will have definitive answers to the following questions before 2006.

Were the Users Satisfied?

What Were the Major Areas of Success or Failure, Weaknesses and Strengths?

How Are the Results Being Used on the Ground?

4.2. Intermediate outputs

The plan for ASB-MA outputs forthcoming in 2006 and 2007 is structured around policy-relevant questions synthesized from stakeholder consultations to identify users' needs (see Annex 7). This status report should help launch assessment activities focusing on specific priority topics listed in section 2.1.5.1 and elaborated in the sections under heading 2.2 (also see Annex 8). Our plan is to organize each team to produce one (or more) ASB Policybriefs on their topic. A draft template for this work is included in Annex 10 and will be reviewed by the assessment teams. The general direction of these Policybriefs will be set by the ASB-MA CLAs, based on results of user needs assessments, to ensure the Policybriefs are in line with ASB user needs. As with the existing ASB series, preparation of these issues will be supported by ASB Global Coordination Office staff with assistance from a professional writing consultant. The bulk of the development, revision and review of each brief will be done by email. This approach has the advantage of producing a set of relatively short, highly-focused, intermediate outputs that can be of immediate value to users. As the set grows to cover a full range of ASB-MA topics, these would then be the basis for compiling a comprehensive assessment product as envisioned at the inception meeting (see section 2.1.5.1). The ASB-MA has published a brochure on this activity in 2005 (See: http://www.asb.cgiar.org/PDFwebdocs/Life_on_the_Edge_MA_Brochure.pdf).

4.3. Broadening scope

The majority of the substantive material presented in this status report is drawn from ASB research and ASB publications (now numbering more than 800). (See http://www.asb.cgiar.org/searchpage.asp). This serves one of our ASB-MA objectives: global synthesis of ASB results. But as the assessment process develops in 2006 and 2007, we also expect to see a broadening of the scope of the scientific evidence that is incorporated into the ASB-MA assessment, thereby also placing the large body of ASB results within a broader scientific context. As part of the data management strategy for ASB-MA, the ASB country and thematic reports' contents are now fully searchable at http://www.asb.cgiar.org/search

4.4. Review

4.4.1. How will the review process for this status report be conducted?

An earlier draft of this status report was distributed to all participating scientists for review, both as a means to review this report but also to accelerate the process of focusing our colleagues' attention on specific ASB-MA topics on which they can contribute as lead or secondary authors. A revised version (version 2.0) of this status report was sent to ASB-MA partners for their review in January 2004. Version 3.0 incorporated suggestions from those reviewers and additional input from colleagues received during the sub-global working group meeting in March 2004 in Alexandria, Egypt. Version 4.0 was prepared for external review, updated to cover ASB-MA progress through August 2004, including synthesis of the results of user needs assessments for Thailand, Brazil, Indonesia, Cameroon, and Peru (Annex 8). The present (final) version (5.0) incorporates all changes up to November 2005 including the proceedings of the Workshop on Scaling up the ASB Millennium Ecosystem Goods Assessment held in Nairobi, Kenya, 4th -7th October, 2004. The proceedings or the Scenarios training workshop (November 2004) are available at: http://www.asb.cgiar.org/ma/scenarios.

4.4.2. How will the review process for your assessment be conducted?

In 2006, sections of the comprehensive product will be sent for review to users in ASB countries and to appropriate experts worldwide. Reviewers may include some experts from scientists active within ASB but it is envisioned that most reviewers either would be users or experts without prior direct involvement in ASB. A list of potential reviewers is being developed.

4.5. Communication

4.5.1. How will the results and findings of your assessment be communicated?

An exciting discussion of how to link ASB-MA findings and products with the broader MA communication strategy has taken off as a result of an email from our colleague, Dagmar Timmer, exploring ways in which ASB products might work to the advantage of the broader MA communications effort. One of the interesting ideas (from Nicolas Lucas) is to expand this initiative to involve other sub-global assessments in a communication strategy with writers and video producers developing material about specific regional groups of sub-global assessments, but for an international audience as well as a regional one. Obviously it will take some additional effort from ASB staff, World Resources Institute, and MA Secretariat to make these ideas concrete. In the meantime, the ASB-MA team is collaborating in production of a video on the Northern Thailand benchmark site by the TVE, which could be a prototype for the broader communication strategy.

4.5.2. What types and formats of products will there be?

As mentioned above in section 4.2, we envision a range of intermediate and comprehensive printed products. These include our established series ASB *Policybriefs* (see Annex 3) and ASB *Voices* (see Annex 4) – both distributed by post and through the ASB website (www.asb.cgiar.org) in English as well as in translation to selected languages. Ultimately we envision the compilation of the assessment results in an attractive, highly-illustrated book. We also are interested in exploring other formats, including policy briefings and seminars, press releases, and development of products using other audio and video media for specific audiences.

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Part VI. Annexes

Annex 1. Contents of "Slash and Burn: The Search for Alternatives"

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Forward by Jeffrey Sachs

The Problem and Approach

Alternatives to Slash and Burn: Challenge and Approaches of an International Consortium *by PA Sanchez, CA Palm, SA Vosti, TP Tomich, and J Kasyoki*.

Thematic Research

Carbon Losses and Sequestration Following Land Use Change in the Humid Tropics *by CA Palm, M van Noordwijk, PL Woomer, JC Alegre, L Arévalo, CE Castilla, DG Cordeiro, K Hairiah, J Kotto-Same, A Moukam, WJ Parton, A Ricse, V Rodrigues and SM Sitompul*.

Greenhouse Gas Fluxes in Slash-and-Burn and Alternative Land-Use Practices in Sumatra, Indonesia *by D Murdiyarso, H Tsuruta, S Ishizuka, K Hairiah, and CA Palm*.

The Potential Role of Aboveground Biodiversity Indicators in Assessing Best-Bet Alternatives to Slash and Burn *by AN Gillison*.

Belowground Biodiversity Assessment: The ASB Functional Group Approach *by DE Bignell, J Tondoh, L Dibog, S Pin Huang, F Moreira, D Nwaga, B Pashanasi, E Guimarães Pereira, F-X Susilo, and MJ Swift*.

Sustainability of Tropical Land-use Systems Following Forest Conversion *by K Hairiah, M van Noordwijk, and S Weise*.

The Forest for the Trees: The Effects of Macroeconomic Factors on Deforestation in Brazil and Indonesia *by A Cattaneo and Nu Nu San*.

Site Specific Alternatives to Slash-and-Burn Agriculture

Sustainable Forest Management for Smallholder Farmers in the Brazilian Amazon *by MVN d'Oliveira, MD Swaine, DFRP Burslem, EM Bráz and HJB de Araújo*.

Permanent Smallholder Rubber Agroforestry Systems in Sumatra, Indonesia *by G Wibawa, S Hendratno and M van Noordwijk.*

Coffee, Pastures, and Deforestation in the Western Brazilian Amazon — A Farm-level Bioeconomic Model *by CL Carpentier, SA Vosti and J Witcover*.

Smallholder Options for Reclaiming and Using Imperata cylindrica (Alang-Alang) Grasslands in Indonesia *by P Purnomosidhi, K Hairiah, S Rahayu and M van Noordwijk.*

National Perspectives

The Western Brazilian Amazon *by JF Valentim and SA Vosti*

The Forest Margins of Sumatra, Indonesia by S Partohardjono, D Pasaribu and AM Fagi

The Forest Margins of Cameroon *by J Gockowski, J Tonyé, C Diaw, S Hauser, J Kotto-Same, A Moukam, R Nomgang, D Nwaga, T Tiki-Manga, J Tondoh, Z Tchoundjeu, S Weise, L Zapfac*

The Peruvian Amazon: Development Imperatives and Challenges *by D White, M Arca, J Alegre, D Yanggen, R Labarta, JC Weber, C Sotelo-Montes, and H Vidaurre*

Northern Thailand: Changing Smallholder Land-Use Patterns *by P Suraswadi, DE Thomas, K Pragtong, P Preechapanya and H Weyerhaeuser*

Cross-Site Comparisons and Conclusions

Land-Use Systems at the Margins of Tropical Moist Forest: Addressing Smallholder Concerns in Cameroon, Indonesia, and Brazil *by SA Vosti, J Gockowski and TP Tomich.*

Balancing Agricultural Development and Environmental Objectives: Assessing Tradeoffs in the Humid Tropics *by TP Tomich, A Cattaneo, S Chater, HJ Geist, J Gockowski, D Kaimowitz, EF Lambin, J Lewis, O Ndoye, C Palm, F Stolle, WD Sunderlin, JF Valentim, M van Noordwijk, SA Vosti.*

Annex 2. Contents of "Environmental Services and Land Use Change: Bridging the Gap between Policy and Research in Southeast Asia"

Environmental Services and Land Use Change: Bridging the Gap between Policy and Research in Southeast Asia. E edited by Thomas P. Tomich, Meine van Noordwijk, and David E. Thomas. Special issue of Agriculture Ecosystems and Environment (2004)
http://www.asb.cgiar.org/pdfwebdocs/Environmental_Services.pdf

Preface

On bridging gaps: by Thomas P. Tomich, Meine van Noordwijk, and David E. Thomas.

Introduction

Policy analysis and environmental problems at different scales: Asking the right questions

by Thomas P Tomich, Kenneth Chomitz, Hermi Francisco, Anne-Marie Izac, Daniel Murdiyarso, Blake Ratner, David E. Thomas, and Meine van Noordwijk.

Quantifying off-site effects of land use change: Filters, flows and fallacies *by Meine van Noordwijk, John Poulsen, and Polly Ericksen.*

Theme 1. Smoke Pollution

A process for community and government cooperation to reduce the forest fire and smoke problem in Thailand *by Peter Hoare.*

Policy responses to complex environmental problems: Insights from a science-policy activity on transboundary haze from vegetation fires in Southeast Asia *by Daniel Murdiyarso, Louis Lebel, A.N. Gintings, S.M.H. Tampubolon, Angelika Heil, and Merillyn Wasson.*

Managing smoke: Bridging the gap between policy and research *by Neil Byron.*
http://www.asb.cgiar.org/pdfwebdocs/AGEE_special_1.S_Byron.pdf

Theme 2. Biodiversity functions

Terrestrial pteridophytes as indicators of a forest-like environment in rubber production systems in the lowlands of Jambi, Sumatra *by Hendrien Beukema and Meine van Noordwijk.*

Assessing biodiversity at landscape level in Northern Thailand and Sumatra (Indonesia): the importance of environmental context *by Andrew N. Gillison and N. Liswanti.*

Agroforestry, elephants, and tigers: Balancing conservation theory and practice in human-dominated landscapes of Southeast Asia *by Philip Nyhus and Ronald Tilson.*

Informing natural resource policy making using participatory rapid economic valuation (PREV): The Case of the Togean Islands, Indonesia *by Jim Cannon and Purbasari Surjadi*.

Biodiversity and ecosystem services in agricultural landscapes: Are we asking the right questions? *by Michael J. Swift, Anne-Marie N. Izac, and Meine van Noordwijk.*
http://www.asb.cgiar.org/pdfwebdocs/AGEE_special_2.S_Swift.pdf

Theme 3. Watershed functions

Lessons from two long-term hydrological studies in Kenya and Sri Lanka *by David N. Mungai, Chin K. Ong, B. Kiteme, W. Elkaduwa, and R. Sakthivadivel.*

Toward understanding the cumulative impacts of roads in agricultural watersheds of montane mainland Southeast Asia *by Alan D. Ziegler, Thomas W. Giambelluca, Ross A. Sutherland, Yinglek Pongpayack, Sanay Yarnasarn, Mike A. Nullet, Jitti Pintong, Thomas Vana, Sathaporn Jaiaree, and Sawatdee Boonchee.*

Conducting economic policy analysis at a landscape scale: examples from a Philippine watershed *by Gerald Shively and Ian Coxhead.*

Valuing watershed services: Concepts and empirics from Southeast Asia *by Subhrendu K.Pattanayak*.

Hydrological functions of tropical forests: not seeing the soil for the trees? *by L.A. (Sampurno) Bruijnzeel.* (http://www.asb.cgiar.org/pdfwebdocs/AGEE_special_3.S_Bruijnzeel.pdf).

Conclusion

Environmental services and land use change in Southeast Asia: from recognition to regulation or reward? by *Thomas P. Tomich, David E. Thomas, and Meine van Noordwijk* (http://www.asb.cgiar.org/pdfwebdocs/AGEE_special_4.S_Tomich.pdf).

Annex 3. ASB Policybriefs

ASB Policybrief #1

"Alternatives to Slash-and-Burn". Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, March 2001. http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief1.pdf

ASB is a global alliance of institutions tackling the interlinked problems of poverty and deforestation in the humid tropics. It is launching a series of policy briefs to identify and transfer policy innovations that will promote equitable development while protecting the environment.

ASB Policybrief #2

"Putting Community-based Forest Management on the Map." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, July 2001.
http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief2.pdf

The agroforestry system developed by the Krui people of southwest Sumatra is a model of productive and sustainable community-based management. Indonesia has taken a bold first step along the path of tenure reform – one that offers lessons for other countries facing similar opportunities to devolve management to the local level.

ASB Policybrief #3

"Deregulating Agroforestry Timber to Fight Poverty and Protect the Environment." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, October 2001.
http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief3.pdf

The right balance of regulation is elusive for many tropical timbers. Too little regulation and rainforests fall to loggers seeking valuable timber. Too much regulation and timber is wasted. The issues are simpler for timber from agroforestry systems … and so is the appropriate policy: free trade for agroforestry timber. The key to success is a careful approach that ensures the right species are chosen for deregulation.

ASB Policybrief #4

"Reducing Smoke Pollution from Tropical Fires." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, June 2002. http://www.asb.cgiar.org/PDFwebdocs/ASBPolicyBriefs4.pdf

Beware of misleading generalizations that cloud the debate about smoke. Most fires in the humid tropics are not wildfires and do not occur in primary forests. Nor are smallholders the only, or even the main,

group responsible for them. In the search for solutions, policymakers need to penetrate the haze of misconceptions to understand the causes of the smoke problem at the ground level.

ASB Policybrief #5

"Balancing Rainforest Conservation and Poverty Reduction." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, February 2003.
http://www.asb.cgiar.org/PDFwebdocs/Policybrief5.pdf

Occasionally it is possible to conserve tropical forests while reducing poverty, but more often these two objectives conflict. Without action to resolve this conflict, tropical forests will continue to disappear.

ASB Policybrief #6

"Forces Driving Tropical Deforestation." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, November 2003.
http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief6.pdf

Shifting cultivation for subsistence food production is seldom the main cause of tropical deforestation. Other forms of agricultural expansion —practiced by smallholders and large landowners alike— tend to be much more important. But the most significant determinant of all is how these land uses interact with, and are affected by, macroeconomic forces, access to markets and a host of other policy and institutional factors.

ASB Policybrief #7

First in a special series on tropical forests and water. "Empowerment through Measurement." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, *(January 2004.)*
http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief7.pdf

Researchers in Southeast Asia are working together with local people to develop practical tools and methods—based on science and local knowledge—that communities can use to assess the environmental impact of their own land use practices and that of the people living upstream. As a result, communities develop a stronger voice in decision making and are more able to resolve conflicts over the use of natural resources.

Annex 4. ASB Voices

ASB Voices #1

"The Riquez Family: Perseverance in the Peruvian Amazon." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, July 2001.
http://www.asb.cgiar.org/PDFwebdocs/ASBVoices1.pdf

"Before, we used to work every day just to stay alive. We used to slash and burn because we didn't know there was another way. I look at these trees (on my farm) now and I am filled with hope. They are beautiful to me. They deserve our care and love. Now we're working to ensure our future." – GREGORIO RIQUEZ

ASB Voices #2

"Prisca Oye: Looking to a Future Beyond the Forests of Central Africa." Edited by TP Tomich and J Lewis. *(ASB Voices of the Future Series).* Nairobi: Alternatives to Slash-and-Burn Program, August 2001.
http://www.asb.cgiar.org/PDFwebdocs/ASBVoices2.pdf

"I hate hoeing in the fields!" –PRISCA OYE, AGE 13 YEARS

ASB Voices #3

"Virgulino da Costa Nascimento: Coming Full Circle in the Brazilian Amazon." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, September 2001.
http://www.asb.cgiar.org/PDFwebdocs/ASBVoices3.pdf

"I want to look into ways to use the forest remaining on my farm instead of clearing it. Someday, maybe I'll even be able to reforest some of my pastures." – VIRGULINO DA COSTA NASCIMENTO

ASB Voices #4

"Elena Trigoso-Grandes: Organizing for Progress and Equality in Ucayali, Peru." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, May 2002.
http://www.asb.cgiar.org/PDFwebdocs/04_Eng.pdf

"Before, I didn't even know how to organize a meeting. When I spoke [in front of a group), I trembled…. Today, through AMUCAU, I am participating at the national level to help develop a forestry strategy for Peru." – ELENA TRIGOSO-GRANDES

ASB Voices #5

"Nicanor Pinedo and Julia Espinoza: Partners on the Path to Progress." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, June 2002.
http://www.asb.cgiar.org/PDFwebdocs/05_Eng1.pdf

" At first, it was difficult to clear the fields without burning. It took more effort, and when we harvested our first crop, our yields were lower than before. But now I see my yields improving with each harvest, as the branches and leaves left behind fertilize the land." – NICANOR PINEDO

ASB Voices #6

"Somkit Kirikumsap: Preserving traditions, conserving resources." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, September 2002.
http://www.asb.cgiar.org/PDFwebdocs/Voices06.pdf

"If we don't respect our traditions, it's the same as disrespecting our elders. If we disrespect our elders, it's the same as disrespecting the forest. Trees give us shade and shelter, and will provide for the next generations of our people. Water will continue to flow out of the forest, as long as the elders continue to pass on the knowledge and traditions of our culture." – SOMKIT KIRIKUMSAP

ASB Voices #7

"Bernadino Dumo: Leading by example in Mindanao, the Philippines." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, October 2002.
http://www.asb.cgiar.org/PDFwebdocs/Voices07.pdf

"My neighbors wanted to know why there was no flooding from my lands during the rains, so they came to ask me to share the technology I was using." – BERNADINO DUMO

ASB Voices #8

"Dwi and Anton: Weighing the risks of insecure land rights in Sumber Jaya, Indonesia." Edited by TP Tomich and J Lewis. Nairobi: Alternatives to Slash-and-Burn Program, October 2002.
http://www.asb.cgiar.org/PDFwebdocs/Voices08.pdf

"We are afraid of being evicted again." – ANTON

Annex 5. Community assessment template questions

1. Define human well-being relevant to the community/context. What are the indicators of human well-being in this context?

2. Define and describe the community in the context of ecosystem management (e.g., level of isolation or connectedness, cohesiveness or fragmentation, demographics, history of human-environment interaction, level of direct dependence on the natural resource base, institutional characteristics – including connectedness,; governance structure).

3. How does governance relate to the community's ability to manage resources and organize itself? What are the equity considerations built into the system?

4. In what ways are assessment paradigms and methodologies in/appropriate to community- based assessments?

5. How do communities shape and evolve with social and ecological change (e.g., by forming institutions, appointing stewards or changing their ecosystem management systems)? How can these be adopted and adapted to other situations and scales? How could these lessons about community responses be applied, and by whom? To what extent are these lessons currently being applied?

6. What has been the impact of globalization (e.g. technology, tourism, trade, disease, MA, trans-frontier conservation/development interests, international conventions, privatization, etc.) on resource use and social structure (e.g. the emergence of new informal markets, illegal use of resources for financial gain, shifts in preferences, changes in value systems, etc.)?

7. What are the cross-scale interactions between drivers and processes at different levels (e.g. policies affecting local level natural resource management processes)? In what way does the social organization for natural resource management accommodate the cross scale interactions between different actors and institutions? How is this linked to capacity of the system to accommodate/deal with changes?

8. What are the indicators or symbols that monitor ecosystem dynamics (e.g. bird migration)? How are these used to guide human actions? What role does group or individual memory and experiences play in this?

9. How do local/traditional institutions take on new roles and responsibilities related to ecosystem management? Which do and don't – and why?

10. What is the impact of 'protected areas' (define for your context), or lack thereof? Does this conflict with human-well being?

11. Are there lessons to be learnt from communities that have already had to deal with crises? How do communities deal with variation, uncertainty and surprise?

12. What are the mechanisms for strengthening a community's ability to restore ecosystem services? Give examples of how the community's well-being was enhanced by restored ecosystem services.

13. What are the gradually changing processes (soil erosion, demographic change, loss of biodiversity) that creep up on the system and lead to ecological change?

14. What are alternative conceptual frameworks (written, oral or visual) that helped your assessment illustrate human well-being and ecosystem services?

Annex 6. Community profiles of ASB benchmark sites

Geographic description	History of land occupation	Number of people or households	Livelihoods	Relationship with natural resources	Religion or cultural group	WWF ecoregion
Peru (Tropical Forest Margins) – Ucayali Valley and Huallaga Valley (74W, 7S and 76W, 5S).	Mix of indigenous groups and settlers from the highlands (migrant farmers).	10s of thousands.	Mixed cropping; agroforestry; pastures; coca; fishing; hunting.	Livelihoods are almost exclusively natural resource based, almost exclusively. Rivers are key in transport, communication, water supply, fisheries, culture. Amazonian fruit trees are a key component of agroforestry systems. Complex agroforests (e.g., peach palm agroforests) combine biodiversity resulting from natural regeneration with managed species.	Majority are Christian (Catholics and Protestants); other indigenous beliefs.	Southwest Amazon moist forest, Iquitos varzea and Napo moist forests.
Western Amazon of Brazil (Tropical Forest Margins) – Acre and Rondonia States (66W, 9S and 61W, 10S).	Mix of indigenous groups, rubber tappers, riverine communities and colonists from elsewhere in Brazil.	10s of thousands.	Ranching; extraction of forest products; fishing; hunting; mixed cropping (patchy).	Livelihoods are almost exclusively natural resource based, almost exclusively. The economy is dominated by pastures and livestock. Road improvement and construction are transforming these landscapes.	Majority are Christian (Catholics and Protestants); other indigenous beliefs.	Purus-Madeira moist forests, Madeira-Tapajos moist forests.
Eastern Amazon of Brazil (Tropical Forest Margins) – Para State (47W, Equator)	Mix of large and small landowners	10s of thousands	To be completed	To be completed	Majority are Christian (Catholics and protestants); other indigenous beliefs.	Tocantis-Araguia-Maranha moist forests

Annex 6 continued						
Geographic description	**History of land occupation**	**Number of people or households**	**Livelihoods**	**Relationship with natural resources**	**Religion or cultural group**	**WWF ecoregion**
Cameroon (Tropical Forest Margins) – Ebolowa-Yaounde Transect (10E, 1N to 10E, 3N).	Mix of indigenous groups.	10s of thousands.	Mixed cropping; agroforestry; cacao; fishing; hunting.	Livelihoods are almost exclusively natural resource based, almost exclusively. People combine their gardens with agroforests. Complex agroforests (e.g., cacao agroforests) combine biodiversity resulting from natural regeneration with managed species.	Indigenous belief systems, sometimes combined with Christian beliefs.	Atlantic equatorial coastal forests.
Mindanao, Philippines (123E, 7N).	Mix of ethnic groups as well as migrants from other islands in the Philippines.	100s of thousands.	Upland food and cash crop systems; lowland rice.	Livelihoods are natural resource based. Natural resources are highly politicized.	Majority are Christian (Catholics and Protestants); other indigenous beliefs.	Mindanao-Eastern Visayas rainforest.
Northern Thailand – Chiang Mai Province (Mae Chaem Watershed) (98E, 18N)	Mix of ethnic groups (hill tribes) as well as lowland Thai have settled at different periods. There is conflict between groups over resource access and ecosystem services (e.g. between upstream and downstream communities), and with the government over the access to forests.	100s of thousands	Upland food and cash crop systems; lowland rice; opium (declining); non-timber forest products	This differs significantly depending on the ethnic group, from strong conservation ethic to profit-maximization through exploitation.	Cultural groups - Karen, Hmong, and other hill tribes as well as lowland Thai.	Kayah-Karen mountain rainforests

Annex 6 continued						
Geographic description	**History of land occupation**	**Number of people or households**	**Livelihoods**	**Relationship with natural resources**	**Religion or cultural group**	**WWF ecoregion**
Sumatra, Indonesia (Tropical Forest Margins) – Jambi Province and Lampung Province (101E, 1S and 104E, 4S).	Mix of large- and small-scale; mix of indigenous people (including a few thousand forest dwellers) and colonists (trans-migrants); forestry, plantation and mining companies (public and private sector). There is a lot of conflict between groups over resource access and property rights, and with the government over forest access.	100s of thousands.	Rubber agroforests; upland and irrigated rice; oil palm; fishing; timber; non-timber forest products.	Livelihoods are natural resource based. Complex agroforests (e.g., rubber agroforests) combine biodiversity resulting from natural regeneration with managed species.	Islam and some indigenous belief systems; matrilineal inheritance among some groups; cultural groups – Jambi, Lampung, Javanese, Minangkabau.	Sumatran lowland rainforests.

Annex 7. Synthesis of ASB-MA users' needs

	***= achievable ** = possible * = doubtful	Bold = highest priority and most achievable *Italics* = desirable if feasible (or may be indicated as gaps)		
Topic	Capacity	Lead author(s)	Assessment question(s)	Status & next steps
Driving forces				
Anthropogenic drivers	***	Geist	What forces drive tropical deforestation?	Done (Policybrief #6)
Biophysical drivers (including invasive species)	*	van Noordwijk?	What are the roles of climate change, invasive species and other biophysical drivers of deforestation and other forms of land cover change?	
Human well-being & ecosystem services				
Provisioning services				
Ecosystem goods	***	Scherr, Joshi, Vosti, (Palm, Sebastian, Tomich)	What are the major ecosystem goods from the tropical forest margins? In which forest and forest-derived land uses are they produced? What share of national production and exports of these goods comes from the tropical forest and forest-derived land uses? How many people depend on these systems for their livelihoods? What are trends in land use, production, and yields? For internationally traded goods, what are trends in relevant world markets? Do deforestation and other changes in land use contribute significantly to agricultural growth? Can these trends continue? How sustainable are these production systems (qualitative assessments here, with quantitative assessments under relevant components of supporting services)? What are the risks (price and yield) associated with production of these goods?	Procedure, checklist, and production matrix drafted, meeting planned for October.
Regulating Services				
C stocks / reducing GHG fluxes	***	Palm with Lasco, Verchot, Cacho,	What is carbon sequestration? Should I [policymakers and local people] be concerned about / interested in carbon sequestration? What is the potential for increasing C stocks in the tropical forest margins and forest derived land uses? Which land use changes hold the greatest potential for	2 ASB book chapters exist. CP to lead next steps.

		Sebastian, Wood	increasing C stocks? How can carbon stocks be evaluated / measured in different land use systems in the humid tropics? What indicators – aboveground, belowground (roots and soil C) -- have been validated for this purpose? Are they cost effective? Replicable?	
Air quality (managing smoke)	*	Tomich, Murdiyarso, Velarde	How can people manage smoke pollution from tropical fires?	Done (PB #4) ; also 3 AgEE articles + concluding chapter
			When (at what thresholds of airborne particulates) does smoke pollution from biomass burning become a serious public health threat? How do seasonal or annual patterns of smoke pollution from biomass burning compare with those thresholds?	SJ Velarde to review literature
Water supply	***	Tomich, Thomas, Chomitz, van Noordwijk, Douglas, Vorosmarty, Richey	How does land cover change at the forest margins affect water supply? What are the micro-climate effects of land cover change? How much of what we think we 'know' about the effects of deforestation on watershed functions in the humid tropics is actually correct? How can water supply be measured / evaluated in different land use systems in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? How are changes in water use in upstream and downstream areas (at local to national scales) affecting competition for water resources?	BNPP PB draft exists Bruijnzeel and Patanayak articles in AgEE BNPP papers in prep TPT to lead follow-up

Regulation of local hydrological hazards (including water pollution) Note: 'local' means within 10 km of the site of the land cover change.	***	Tomich, Thomas, Chomitz, van Noordwijk, Bruijnzeel, Ziegler	What are the local hydrological hazards and local effects on water flows resulting from deforestation and changes in land cover? When and in what situations are the risks highest? Specifically, how does the pattern of trees and other vegetation affect the risks of flooding, sedimentation and landslides? What other land use activities (e.g. road construction, settlements) affect these risks? How can I [a villager] get clean drinking water? When (at what thresholds of land use change) does pollution from runoff of agricultural chemicals used in forest-derived land uses (fertilizers, herbicides and pesticides) become a serious public health threat? How can local hydrological hazards be measured in different land use systems in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? When (at what thresholds of land use / cover change) do local hydrological hazards become a serious threat to people and property? How effective are modeling techniques for characterizing watersheds for risks of flooding, erosion or landslides using data at different scales of resolution? <u>Specific response</u>: How can risk of death and property damage from flooding, landslides, and sedimentation be minimized in catchments in mountainous areas?	BNPP PB draft exists Also see AgEE collection TPT to lead follow-up
Buffering lowland flooding Note: 'lowland' means more than 10 km from site of the land cover change	***	Tomich, Chomitz, Richey, Douglas, Wood	What evidence exists linking deforestation upstream to severe floods over large areas in the lowlands? How can risks of downstream flooding be measured in different land use systems in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? When (at what thresholds of land use/cover change) does the risk of severe downstream flooding become a serious threat to people and property in the lowlands?	BNPP papers in prep Draft BNPP technical note exists TPT to lead follow-up

Regulation of weeds, pests & diseases of crops & livestock	*	Swift, Weise, van Noordwijk, Hairiah	Are there particular advantages or risks concerning weeds, pests and diseases for agriculture at the tropical forest margins? How do deforestation and other land cover changes at the tropical forest margins affect farmers' weed, pest, and disease problems? How can risks of pests and diseases be evaluated/measured in different land use systems in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? What is the relationship between soil fertility and weeds, pests, and diseases? How does the tendency toward simpler, intensified systems (e.g., monocultures) at the local scale affect risks of weed, pest and disease problems? And, at the regional scale how does it affect the risk of large-scale weed, pest and disease problems? When (at what thresholds of land use / cover change) do risks of weed, pest and disease problems become serious threats to crops and livestock? (Conversely, are there cases where risks decrease? If so, for what thresholds of land use/ cover change?) To what extent does the use of herbicides and pesticides now affect water quality in the tropical forest margins and forest derived areas? What about trends for the future? <u>Specific response</u>: How can weed, pest and disease problems be managed? Is this economically feasible? (Specific concerns mentioned include: rodents, wild pigs, snakes, various weeds, savannah termites, cocoa black pod disease, cassava root scale)	Sustainability chapter in ASB book. AgEE articles by Swift et al and conclusion by Tomich et al TPT to contact lead authors in August
Soil Resources				
Nutrient supply & soil fertility	**	Swift?, Hairiah?, van Noordwijk? Palm	**How do different land use systems affect nutrient supply and soil fertility? Specifically, how do trees and fallow systems affect soil fertility?** How can nutrient supply and soil fertility be evaluated/measured in different land use systems in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? When (at what thresholds of land use / cover change) do soil nutrient exports threaten farm productivity? How extensive are soil fertility problems and where do they occur in the tropical forest margins and forest-derived land uses? How much chemical fertilizer is used in soil fertility management in 'degraded' or 'marginal' forest-derived lands? How does the use of chemical fertilizers affect water quality? To what extent is this a problem? What about trends for the future?	ASB book chapters on sustainability and on carbon TPT to contact lead authors in August

			Specific response: What are the techniques for maintaining, improving, or restoring soil fertility? Are they economically feasible?	
Maintaining soil physical properties, including avoidance of erosion, compaction	**	F. Agus, J Alegre, A Ziegler	How do different land uses affect soil physical properties? Specifically, how do trees, fallow systems, use of fire, or tractor tillage affect soil erosion, compaction, and other physical properties? How can erosion, compaction and other soil physical properties be evaluated/measured in different land use systems in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? When (at what thresholds of land use / cover change) do erosion, compaction, or degradation of other soil physical properties threaten farm productivity? **How extensive are erosion, compaction and other soil physical problems and where do they occur in the tropical forest margins and forest-derived land uses?** How does soil erosion affect water quality? To what extent is erosion from forests and from forest derived land a problem now? What about trends for the future? Specific response: What are the techniques for maintaining, improving, or restoring soil physical properties? Are they economically feasible?	Sustainability chapter in ASB book Ziegler et al paper in AgEE volume CP to contact lead authors
Soil types, inherent capabilities & constraints, conditions & trends in soil resources	**	Palm, Sebastian, Wood	For predominant soil types of the tropical forest biome, what are the inherent capabilities/ constraints for various land uses (crops, trees, pastures, forests, etc)? What is soil 'health'? How can soil health be evaluated / measured in tropical forests, forest margins and forest-derived land uses? What is soil 'degradation' (including soil fertility problems, erosion, compaction, other soil physical problems)? How is soil degradation defined and measured for tropical forests, forest margins and forest-derived land uses? What indicators have been validated for soil health and soil degradation? Are they cost effective? Replicable? What are the conditions and trends in soil health/degradation in the tropical forest margins and forest derived land uses? How are they linked to land use/cover change? **How much degraded land/degraded soil is there in the tropical forest margins and forest-derived land uses? Where is it?** When should policymakers worry about soil degradation? What are appropriate indicators? When (at what thresholds of land use / cover change) does soil resource degradation threaten national food security or economic development?	This topic builds on the 2 preceding topics: "nutrient supply & soil fertility" and "soil physical properties". CP to lead

Biological resources				
Belowground biodiversity Note: this topic did not emerge as an issue in the user needs consultations. Science is only beginning to explore this topic.	**	Swift, Bignell	Should people be concerned about trends in belowground biodiversity? (What are the functions of belowground biodiversity?) How can belowground biodiversity be evaluated / measured in different land use systems in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? What are the conditions and trends in belowground biodiversity? Are they linked to land use and cover change? If so, how? When (at what thresholds) does loss of belowground biodiversity threaten national food security or economic development? Specific response: What are the techniques for maintaining, improving, or restoring belowground biodiversity? Are they economically feasible?	ASB book chapter AgEE synthesis paper on biodiversity ASB country reports (Brazil and Peru) TPT to contact lead authors in August
Aboveground biodiversity assessment methods	**	Gillison, Kapos	What is biological diversity? What tools and approaches are there for evaluating how much biological diversity has been lost due to tropical forest disturbance/conversion? What is the biological diversity potential of the forest margins and forest-derived landscape mosaics)? How can we assess it? What tools are there for assessing conditions and trends in biological diversity in complex landscape mosaics? How do different types of landscape mosaics serve as habitat barriers or corridors for different types of wildlife, vegetation, other organisms?	ASB book chapters Papers in AgEE biodiversity section and conclusion
Aboveground biodiversity conditions & trends	*	Gillison, Kapos	What are the endangered species in the forest margins? Why are some species disappearing? What are the conditions and trends in aboveground biodiversity? Are they linked to land use / cover change? How? What is the role of logging, hunting, fishing and gathering in reduction of species? What are the relative impacts of these activities by various stakeholders? How many (what proportion of) indigenous natural forest species are found in forest derived land uses? How many (what proportion of) species found in forest-derived land uses are not present in natural forests?	
Aboveground biodiversity, ecosystem functions & sustainability	*	Gillison, Kapos	What are important elements of biodiversity (e.g. keystone species) in the tropical forest margins and forest-derived land uses? How much does biodiversity richness increase with the length of fallow? Does that richness affect the restoration and quality of the fallow?	

			Forest management may eventually produce forests comprised primarily of commercially valuable species. What might be the environmental consequences of this? At what thresholds (of forest disturbance, fragmentation, land use/cover change) do tropical forests and landscape mosaics loose their value as habitat for wild organisms?	
Human resources				
Human population densities by ecoregion within the humid and subhumid tropical broadleaf forest biome (of WWF)	***	Sebastian, Tomich	**For each ecosystem within the humid and subhumid tropical broadleaf forest biome (of WWF), what is the:** - **total area 'protected'** total rural area outside protected areas total rural area outside protected areas that is deforested rural population density (relative to rural area outside protected areas). What are the trends in these population densities?	Template exists for Policybrief (BNPP PB #5) TPT and K Sebastian to lead
Ecological knowledge & ecosystem condition	*	Joshi	What is ecological knowledge? What are different ecological knowledge systems? How is the conservation of biological resources related to, and supported by, different ecological knowledge systems (local experiential, scientific…)? What ecological knowledge and information do we need to manage land use mosaics? Can ecological knowledge be catalogued / measured for tropical forests, forest margins, and forest derived systems? What methods have been validated for this purpose? Are they cost effective? Replicable? When (at what thresholds in terms of key types of knowledge – 'keystone knowledge' – or numbers or key types of expertise 'keystone people') does lack of ecological knowledge threaten sustainability of ecosystem functions, national food security or economic development? Are current coping strategies at local levels adequate to deal with emerging challenges (e.g., climate change)? (also listed under 'resilience'). What are conditions and trends in ecological knowledge? Are local and scientific knowledge complimentary or mutually contradictory? How is the local knowledge base affected by scientists and tourists? How is the local knowledge base affected by economic change? Specific response: How can farmers/scientists collaborate to accelerate learning?	TPT to contact lead author to discuss

Human well-being, sustainable livelihoods, & poverty reduction	***	Vosti, Tomich	Do deforestation and other changes in land use contribute significantly to poverty/ poverty reduction? How can poverty be measured in the humid tropics? What indicators have been validated for this purpose (e.g., population living on less than US$ 1 per day, poverty gap, food expenditure share of lowest quintile)? Are they cost effective? Replicable? How can we better identify the poor living in the tropical forests / forest margins / forest-derived areas in order to design better interventions to reduce poverty? How can we measure some of the non-monetary, private or social benefits associated with rural farming / forest management activities? Are there important thresholds in poverty reduction? If so, what are they and how can they be measured? Specific responses: How have government policies, services, and projects affected local livelihoods, agricultural production and ecosystem services? How have the effects been distributed among spatial areas and among ethnic, age and gender groups?	Pending work on conditions & trends in ecosystem services; also requires additional funding; work on this component of the ASB-MA assessment will not start until 2005
Determinants of human well-being:				
Equity & social justice	*		What are the main conflicts of interest at the forest margins? Who are the winners and losers? How can equity and social justice be evaluated / measured in the humid tropics? What indicators have been validated for this purpose (distribution of consumption, income or land; f/m ratio for education enrollment, f/m ratio for literacy? Are they cost effective? Replicable? What are the conditions and trends in equity and social justice?	
Resource access & asset security	**		How can resource access and asset security be evaluated / measured in the humid tropics? What indicators have been validated for this purpose (e.g. distribution of land by size of holding or operational unit)? Are they cost effective? Replicable? What are the conditions and trends in resource access and asset security? Specific response: How can vulnerable people (widows, women, ethnic minorities) have secure access to land for farming?	
Market access &	*		How can market access and infrastructure be evaluated / measured in the humid tropics? What indicators have been validated for this purpose (road density, phone	

infrastructure			lines per capita)? Are they cost effective? Replicable? What are the conditions and trends in market access and infrastructure? What role has infrastructure investment (roads, electrification, telephones, internet) played in supporting economic development in rural areas at the forest margins? What have been the environmental consequences?	
Income & employment opportunities Note: link to ecosystem goods assessment	***		How can income and employment opportunities be evaluated / measured in the humid tropics? What indicators have been validated for this purpose (returns to labor or land, labor requirements)? Are they cost effective? Replicable? What are the conditions and trends in income and employment opportunities? Are income-generating activities within extractive reserves (e.g. Brazil nut extraction, rubber tapping, timber extraction, cattle production, annual crop production, AFS) economically viable and environmentally sustainable? What are the current and potential roles for non-land-based enterprise and off-farm employment in local livelihoods? What are the current and potential roles for (national and international) ecotourism in local livelihoods? Specific responses: What can be done to improve the livelihoods of marginalized groups such as ethnic minorities, Brazilian rubber tapers and those inhabiting and cultivating seasonal flood plains (*riberinhos*)?	
Educational opportunities & access to information	*		How can educational opportunities and access to information be evaluated / measured in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? What are the conditions and trends in education and access to information? How have education and training opportunities (especially in non-agricultural economic sectors such as tourism, industry and services) affected poverty reduction among people living in the forest margins? What effect do education and training have on decisions to migrate to (or from) the forest margins?	

Constituents of human well-being:				
Household food security & human nutrition Note: link to ecosystem goods assessment	**		How can food security and human nutrition be evaluated / measured in the humid tropics? What indicators have been validated for this purpose (e.g., food expenditure share of lowest quintile, child anthropometry (underweight infants and children), calorie availability)? Are they cost effective? Replicable? What are the conditions and trends in food security and nutrition? What are the different implications for household food security of different land use alternatives? Different combinations of these alternatives?	
Human health Note: link to assessments of air quality; local hazards (water quality, water pollution from ag chemicals); soil resources (sedimentation).	*		How can human health be evaluated / measured in the humid tropics? What indicators have been validated for this purpose (e.g., infant, child, maternal mortality, immunization and disease prevalence)? Are they cost effective? Replicable? What are the conditions and trends in human health?	
Social relations, including cultural, spiritual & religious expression; aesthetic and recreational values	*		How can social relations be evaluated / measured in the humid tropics? What indicators have been validated for this purpose? Are they cost effective? Replicable? What are the conditions and trends in social relations? Specific response: How can local people have secure access to significant cultural, spiritual, religious sites?	

Ecosystem resilience & environmental security Note: thresholds will be assessed within each conditions and trends topic above Note: links to assessments of local hazards (flooding, landslides); lowland flooding; pests and diseases.	*	Palm, van Noordwijk	What are some of the major uncertainties we have to consider at the forest margins? How much / what type of forest conversion can be tolerated with minimal effects on environmental services? What mix of landuses at the landscape level; threatens ecosystem resilience? When (at what thresholds of land use/cover change) does loss of ecosystem resilience threaten ecosystem functions, national food security, or economic development? Are current coping strategies at local levels adequate to deal with emerging challenges (e.g., climate change)? (also listed under 'ecological knowledge')	Pending input from ecosystem conditions & trends assessment and from scenarios exercises in early 2005
Tradeoffs within/across spatial/temporal scales		Palm, Tomich		
Environment – development tradeoffs	***	Tomich	**What are the tradeoffs/synergies between intensification, economic development and environmental conservation?**	PB #5 done
Tradeoffs among provisioning and regulating services	**	Palm, Sebastian, van Noordwijk, Tomich	**What are the spatial and temporal tradeoffs between regulating services and the supply of ecosystem goods (food, feed, fiber)?** *For example, who benefits and who loses from constraints placed on land use in mountain area watersheds? Is there a shared view that the distribution of costs and benefits is equitable?*	Pending input from conditions, trends & well-being assessments
Human well-being and biological diversity	*	D Russell?	How does biological diversity affect human wellbeing? What benefits do local people derive from biodiversity currently? Are there costs? What is the impact of conservation strategies on local livelihoods?	?
Tradeoffs between provisioning services and biological diversity	**	Gillison, Tomich	What are the tradeoffs between biological diversity and the supply of ecosystem goods (food, feed, fiber)? What is the difference in profitability between complex and simple treecrop systems? How can I [a farmer] increase returns on my land and still maintain biodiversity? How many species can I [a farmer] have on my land without having bad interactions?	Pending input from conditions & trends and human well-being assessments

Annex 7a. Assessment questions for Thailand

SERVICES	**ASSESSMENT QUESTIONS**
	National Level (policy shapers)
Food, feed, fiber, etc.	What are the current major biophysical and economic tradeoffs between agricultural profitability and environmental services of different agroforestry land use patterns? What are the past and current roles of livestock and forest products in local livelihoods and agroecosystems?
Carbon sequestration, including atmospheric regulation	na
Air quality	
Water supply	What influences do filter strips (physical and biological) and channels (including roads and trails) have on watershed services provided by agroforestry landscapes?* How effective are modeling techniques for characterizing watersheds for risks of flooding, erosion or landslides using data at different scales of resolution? How can risk of death and damage from floods and landslides be minimized in mountain area sub-catchments? How are changes in water use in upstream and downstream areas (at local to national scales) affecting competition for water resources?* What technologies and incentives would help reduce water use in upstream and downstream areas? Can communities in local sub-watersheds conduct systematic monitoring of the watershed services they provide? If so, can these local sub-watersheds organize themselves for overall monitoring and management of larger river sub-basins and basins?
Nutrient supply	How does use of agricultural chemicals affect downstream water quality?*
Regulation of crop pests and diseases	
Soils	How do practices such as use of fire, tractor tillage or agricultural chemicals affect impacts on environmental services?* How effective are alternatives to contour strips in reducing erosion losses on agricultural fields? What incentives are necessary for effective establishment and maintenance of filter strips and conservation farming practices?
Biological diversity, including genetic resources	How do different types of agroforestry landscapes serve as habitat barriers or corridors for different types of wildlife?* What are the relative impacts of hunting, logging and forest product harvest by various stakeholders?

Ecological knowledge	How can local knowledge and culture contribute to sustainable watershed management? How do spatial configurations of forest patches and trees in mosaic agroforestry landscapes affect provision of environmental services?* Can forest and tree components of mosaic agroforestry landscapes be locally managed in a sustainable manner? Can increased recognition of and local authority over community forests increase ability of local communities to manage them sustainably? Can production of tree products and NTFPs in complex agroforest configurations that build on local knowledge help improve both local livelihoods and provision of environmental services?* How can science-based tools be used to improve communications and negotiations among stakeholders at different levels?* How can TAO build on and support informal local groups and networks to improve local natural resource management? How can NGOs help strengthen capacity of local communities and institutions to manage natural resources sustainably over the long term?
Ecosystem resilience / thresholds (temporal and spatial)	What are the impacts on environmental services (compared to natural forest) of alternative forms of agricultural land use (various forms of shifting cultivation, fixed upland fields, intensive horticulture, various forms of agroforestry) in mountain areas? - soil erosion and sedimentation - stream flow - quantity, timing, quality - plant biodiversity, functional complexity - carbon stocks, methane emissions How much of what types of forest conversion can be tolerated with minimal effects on environmental services?* What constraints should be placed on land use in mountain area watersheds?

Human well-being, sustainable livelihoods, and poverty reduction	How have past and current government policies, services, and projects affected local livelihoods, agricultural production and agroecosystems? How have forces such as population growth, migration, and social and economic integration affected local livelihoods, agricultural production and agroecosystems? How have the effects of these forces of change been distributed among spatial areas and among ethnic, age and gender groups? How should poverty be measured, and how does distribution of effects of forces of change compare with distributions of poverty? What are the relative profitabilities and impacts on local household livelihoods of alternative forms of agricultural land use found in Mae Chaem? What are the current and potential roles for ecotourism in local livelihoods? What are the current and potential roles for non-land-based enterprise and off-farm employment in local livelihoods? How could government policies and services help to further improve local livelihoods and reduce environmental tradeoffs? How can management of forest and tree components of mosaic agroforestry landscapes for commercial production of NTFPs be developed that would both improve local incomes and help assure their longer-term maintenance in the landscape? How can such production help achieve goals in line with the 1 tambon 1 product program? How can upstream and downstream villages of multiple ethnic groups organize themselves to better manage local sub-watersheds? How can local land use zoning be developed to meet the needs of both local livelihoods and environmental sustainability? Can agreements on local land use zoning provide a basis for formal recognition of land use in mountain watersheds? How could local land use zoning agreements be monitored for compliance in a manner that insures transparency and accountability? How can local land use zoning, local resource/ watershed management networks, and partnerships with forestry agencies assure protection of critical watershed forest, parks and wildlife sanctuaries? Which environmental service issues are best managed by different scales/ configurations of social organization? Who benefits and who loses from constraints placed on land use in mountain area watersheds? Is there a shared view that the distribution of costs and benefits is equitable? If distribution of costs and benefits are not seen as equitable, what types of rewards (e.g. tenure, services, subsidies, payments) could improve equity and incentives? What policies and institutional arrangements would be required for these reward mechanisms to work effectively?

Annex 7b. Assessment questions for Brazil

SERVICES	ASSESSMENT QUESTIONS	
	National Level (policy shapers)	**Local Level (farmers)**
PROVISIONING SERVICES		
Food, feed, fiber, etc.	How can we better locate and identify the rural poor, and help them overcome the food insecurity they face? How can we protect smallholders from changes in the structure of markets, where the food/fiber market is becoming dominated by supermarkets who want quality and reliability, which is more difficult for smallholders to ensure?	How can we compete with larger companies for access to supermarkets? What might the terms of trade be that we could hope for? We've heard of fair trade products – is this one way to enter these markets? Is there anything we can do as local organizations, by banding together? Are there examples of community success with supermarket access?
REGULATING SERVICES		
Carbon sequestration, including atmospheric regulation	What potential is there in international carbon markets to complement national programs for compensating smallholders for environmental services?	
Air quality	What can we do to control the air pollution that results from the burning of forests and affects the health of individuals living even hundreds of miles from the burning sites?	How can we protect ourselves from **health problems caused by smoke**, such as breathing problems?
Water supply	What are some of the effects of deforestation and land use on local hydrology and water pollution? What similar countries have experience with prolonged seasonal dry periods and mechanized annual crop production? What are their lessons?	
Nutrient supply		
Regulation of crop pests and diseases	How do pesticides affect local hydrology and water pollution? What are some alternatives for regulating crop pests? How can we protect ourselves from major diseases like foot-	

	and-mouth in the future? Attending to them after the fact is a huge sink for resources.	
RESOURCE BASE AND SUPPORTING SERVICES		
Soils	What are some of the improvements in pasture and livestock management which have the potential to dramatically improve pasture productivity, extend pasture life and increase the profitability of cattle operations? Is there any way we can take care that this improved pasture productivity limits (rather than increases) pasture expansion?	How can I improve my pasture management? What are some of the new techniques I should know about?
Biological diversity, including genetic resources	What is the difference in economic performance of shade (perhaps multi-purpose) trees vis-à-vis man-made edifices (barns, etc.) for shade provision to cattle herds? How might a government-led program of recovering the borders of streams and larger waterways be implemented to maximize benefits to farmers such as increased stream flow to sustain larger cattle herds, and increased supply of wood products needed for constructing / maintaining fences, barns, etc.? How can fisheries and aquatic resources complement other farming systems? There is a risk that forest management will eventually produce forests comprised primarily of species valuable to landowners. What might be the environmental consequences of this? What can we do about it?	What is the difference in economic performance of shade (perhaps multi-purpose) trees vis-à-vis man-made edifices (barns, etc.) for shade provision to cattle herds? We've heard a lot about fish farming. How can that be a part of our farming activities?
Ecological knowledge	We are frustrated by the unavailability of scientific information to guide policy decisions. How can we work better with **researchers** to ensure that their projects and findings are more useful for policy – and delivered in a timely fashion? How can we fill the need for predictive capacity in collaboration with the researchers, especially on how policy action affects development objectives? Are there useful	As small-holders, we often have less access to price data, technological innovations, etc than larger-scale producers. How can we **improve the timeliness and quality of information** we receive?

	modeling tools we should be adapting to Brazil's needs? What can we do to strengthen our **agricultural extension** service, which suffers from lack of resources and incomplete training especially on forest-based production systems? How can we ensure that effective policy tools already tested in Brazil are not lost in the process of decentralization? How can we support environmental teaching in the country's education system, such that teachers and school aged children learn about the importance of environmental services and how to take care of their natural resources?	
RELATED TOPICS		
Ecosystem resilience / thresholds (temporal and spatial)	What are some of the reasons for the **spike in deforestation** in the Brazilian Amazon, which reached on of its highest levels in 2002? And what can we do to better monitor and control the conversion of forests to agriculture? What kind of technology can put in place to help us monitor land use, fires and other things? What would the cost be? Where will the next 20 years of agricultural growth come from and what are some innovative ways we can **increase productivity growth** in established agricultural areas?	I have recently migrated from Rondonia to Mato Grosso. How do I best manage my land?
Human well-being, sustainable livelihoods, and poverty reduction Human well-being, sustainable livelihoods, and poverty reduction, continued	How can we **identify and measure the environmental services** provided by forests and alternative land use systems? How could we use this information in our new federal government programme (in 17 Amazonian sites) to develop **mechanisms for compensating** individuals / smallholders managing these forest and alternative systems? Who would pay for the compensation? **Road construction** is important to our economy. What are some of the practical ways we can reduce the environmental consequences of roads over the long term in Brazil? Are there lessons we can share with neighboring countries regarding roads-deforestation links we have found in Brazil?	What mix of our own innovations and new production technologies can help us **sustain the gains from forest conversion**? How can we **increase our income significantly** from farming and agroforestry, especially when we are hurt by low market prices and low returns to our efforts in the overall supply chain? Are there other activities we can try? Even though we work hard and improve our farming activities, we remain poor. As we start to see benefits from increased production, how can we protect ourselves from seasonal swings in income that often come with these farming and extractive activities? Is

	Subsidized credit has been helpful in promoting and establishing particular agricultural production activities, especially as farmers often have access to insufficient credit. What are the (short and long term) environmental effects (via deforestation) of these loans? How can we **improve the market** for small scale farmers, especially improving commercialization of the products from farming and agroforestry systems? How can we help small-scale farmers meet **product quality standards** for non-local outlets? What can we do to better understand and manage the effects of **international/regional integration** in the Amazon, especially the social, economic and environmental effects of the imminent dramatic increases in cross-border flows of labor, inputs and products? What are some strategies for alleviating poverty in Brazil, while achieving key environmental objectives? What are the tradeoffs? Although cash income may not increase, how can we measure some of the non-monetary, private or social benefits associated with rural farming / forest management activities? What are some of the potential tradeoffs between **individual and community** vulnerability from agricultural and extractive activities, resulting from e.g. slower income growth, increased seasonal swings in income, and how can we mitigate these? How can we help ensure an appropriate (and viable) mix of **income-generating activities within extractive reserves** (e.g. Brazil nuts, rubber tapping, timber, cattle, annual crops, agroforestry)? What can be done to improve the livelihoods of marginalized groups such as rubber tapers and those inhabiting and cultivating seasonal flood plains (riberinhos)? How could we best spend a portion of the substantial World Bank loan to Brazil for the development and management of the forest sector to benefit smallholders and the environment?	there anything we can do as a **community** to support each other?

Annex 7c. Assessment questions for Indonesia

SERVICES	ASSESSMENT QUESTIONS	
	National Level (policy shapers)	**Local Level (farmers)**
PROVISIONING SERVICES		
Food, feed, fiber, etc.	What is the contribution to national supply of these goods from production at the forest margins? How do these systems differ in terms of their effect on equity?	What is the sustainability of the production systems for these goods? What is the potential for productivity increase? What is the risk associated with production of these goods?
REGULATING SERVICES		
Carbon sequestration, including atmosph. regulation	Is there an opportunity to increase carbon sinks and be remunerated for this?	What are the micro-climate effects of land cover change?
Air quality	What can the government do to manage / reduce smoke pollution?	What are the alternatives to burning? What are the health effects of breathing smoke? When does the smoke concentration become dangerous? For whom (e.g. children, sick)?
Water supply	How can Rp 10 trillion (approximately 1.25 billion USD) of national reforestation funds be spent over five years in a way that improves environmental services and livelihoods that is politically popular at the district level and that builds capacity for sustainable development at the local level? What is the role of land use in water security at the watershed / regional level? How does land use affect sedimentation?	How does land cover change affect quantity, quality and timing of water flow? Specifically, low-dry flow, flooding, yield…
Nutrient supply	What is the role of fertilizer policy in the integrated nutrient management in the uplands, particularly degraded or marginal lands?	How do land use alternatives and management techniques affect nutrient supplies? What is the relationship between nutrient management and pest management?

Regulation of crop pests and diseases	What is the opportunity for integrated pest management in the forest margins? How does the tendency toward simpler, intensified systems (e.g. monocultures) at the regional scale affect risk of large-scale pest and disease problems?	How does land cover change affect pest and disease problems for the farmers?
RESOURCE BASE AND SUPPORTING SERVICES		
Soils	How much degraded land is there? How would we define 'degraded' for the forest margins? What is the scope / opportunity for restoring soils in degraded lands, including imperata grasslands?	What are the techniques for managing or enhancing productivity of land at the forest margins (especially degraded soils)?
Biological diversity, including genetic resources	What tools and approaches are there for evaluating how much biological diversity has been lost in Indonesia? What tools are there for assessing biodiversity in complex landscape mosaics (hamparan)? How would one go about valuing biodiversity in these mosaics? How can Indonesia significantly reduce its loss of biodiversity by 2010, as agreed at the World Summit on Sustainable Development? What are the roles of ex situ (in addition to, and in contrast to, in situ) conservation strategies, especially in countries facing rapid change in the state of their biological resources? Who "owns" biological resources? What system of property rights over biological and genetic diversity is required to ensure that these resources are recognized, protected, used and rewarded, as well as that access is guaranteed? How is the conservation of biological resources related to, and supported by, different ecological knowledge systems (local experiential, scientific…)?	What benefits do local people derive from biodiversity currently? What is the potential for increasing the value of biodiversity at a local level? Who represents minority groups, especially nomadic communities (e.g., Orang Rimbo), in negotiations about access to and use of biological resources? What are some mechanisms for sharing access to biological resources with ethnic minorities?

Ecological knowledge	What system of intellectual property rights is required to ensure that local knowledge is recognized, protected, used and rewarded? How can policy support the bringing together of local knowledge with scientific knowledge to create workable knowledge systems?	Is there anything that farmers don't know? What is the complementarity between local and scientific knowledge? How can farmers blend their local knowledge with scientific knowledge? In situations that are changing quickly, how can the learning process to rapidly update local knowledge be supported? How is the local knowledge base affected by scientists and tourists? How is the local knowledge base affected by economic change? Note: Local ecological knowledge (LEK) includes both 'knowledge' and practice, and includes indigenous knowledge.
RELATED TOPICS		
Ecosystem resilience / thresholds (temporal and spatial)	What are the tradeoffs and synergies between intensification, economic development and environmental conservation? What mix of land uses at a landscape level threatens ecosystem resilience?	Are current coping strategies at a local level adequate to deal with the kind of challenges that may occur (e.g. climate change)?
Human well-being, sustainable livelihoods, and poverty reduction	Issues including: Market access Income generating opportunities Health (public health…) Cultural, spiritual and religious values Educational opportunities Access to information Aesthetic values	

Annex 7d. Assessment questions for Cameroon

SERVICES	**QUESTIONS D'ÉVALUATION**	
	Niveau National (Conseiller de Politique)	**Niveau Local (Paysan)**
SERVICES DE PRÉLÈVEMENT		
Nourriture, alimentation animale, fiber, etc.	What is the importance of the forest margins for food security? How do the forest margins contribute to sustainable agricultural growth? How many people's lives are dependent on these forest mosaics - living in the forest margins and involved in production? What are the opportunities for increased productivity? Do we have enough expertise and technologies to provide these services at the forest margins? What are the best approaches to sustainable development at the forest margins? What is the importance of the forest margins for national income generation? As you use the forest margins, what are the risks involved in the use of food technologies (e.g. GMOs, pests and diseases)? What are the tradeoffs between biological diversity and the provision of food, feed, fiber? What are the systems of resource exploitation at the forest margins? What are the forest margins? What are the export product markets and price prospects for food, feed and fiber?	How can I make more money at the forest margin? How can I reach the market? How can I use the forest to treat my diseases (medicinals)? What are some of the legal barriers I might face in getting to the market (trading) or from harvesting what is available? How can they be removed or circumvented? The forest is a barrier to production. How can I deal with the labour constraints for clearing forests? How can I make sure that I always have access to meat and fish to hunt?

SERVICES	QUESTIONS D'ÉVALUATION	
	Niveau National (Conseiller de Politique)	**Niveau Local (Paysan)**
SERVICES DE RÉGULATION		
Séquestration de carbone, y compris le régulation du climat	What are carbon sequestration and the CDM? Should I be concerned about / interested in carbon sequestration? Who bears the greatest costs and benefits, who needs it (winners and losers)? How can we evaluate carbon stocks in different land use systems? Who has the expertise (or how can we acquire it)? How do you implement a system of carbon management? How could we manage the revenue from trading? How do other countries do it? What is the experience of other developing countries? What is the relationship between carbon trading and economic growth? Would it benefit us? How much money can we make from carbon trading? How much money could we make? What is the risk? How long can it last? Is this just a passing fad? Who would be the implementation agents for this kind of system?	What are carbon sequestration and the CDM? What could my role be? How can I benefit and get that money? What is the risk of taking this money? Is there a hidden agenda? What are you paying us for? Are outside people buying our forests? What is the government doing about CDM? Who are the vested interests? Can I trust this? Who controls the money, the rules of the game, who will monitor? If it succeeds, what will happen to me? If it fails, what will happen to me? How long can it last? Why are you bothering me?
Qualité d'air	Not really a problem.	Fire is the problem locally, but not smoke. How can we better manage bush fires?
Approvisionnement en eau	How does land use change at the forest margins influence water levels? Sedimentation? Electricity supply? As the inland valleys are used more and more for off-season cropping, how does that affect water supply at the local level?	How can I get clean drinking water? Flooding is not a big problem. As more water is used for off-season cropping since people are going into the inland valleys (bafons) for cropping, will water be available off-season for agriculture and fisheries (dry season)? And will fish be available?

SERVICES	**QUESTIONS D'ÉVALUATION**	
	Niveau National (Conseiller de Politique)	**Niveau Local *(Paysan)***
Apport nutritive (nutrient supply)	How can I decide about the allocation of fertilizer subsidies? What crops are best adapted to the soils at the forest margins?	What crops are best suited to the soils I'm working on? How can I manage my soil nutrients better so that I don't have to cut down more forests? What would be the long-term effect of using chemical fertilizers in the forest margins (on taste of crops, soil quality, etc.)? What system of fertilizer(s) can I best use that would give me a good return on my money and still yield a profit? What are the costs and benefits? Are there cheap alternatives? Natural/organic alternatives? Combinations? How can trees on farms affect the nutrient supply? How is my fallow system affecting nutrient supply / restoration of nutrients?
Règlement des insects nuisibles et des maladies agricoles	What is the ecology of cocoa black-pod disease at the forest margins? How can we manage it? What is the ecology of cassava root scale at the forest margins? How can we manage it?	How can I manage cocoa black-pod disease? Cassava root scale? How can I manage rodents in food and cash crops? How can I manage savannah termites, which become a problem at my farm, as they enter through the forest frontier? How can I manage weeds on my farm?

RESSOURCES NATURELS ET DES SERVICES DE SOUTIENT		
Constitution des sols et développement du cycle nutritionnel	When should I start to worry about soil resource degradation? (Not a big issue.)	How can I maintain soil fertility and yield?
SERVICES	**QUESTIONS D'ÉVALUATION**	
	Niveau National (Conseiller de Politique)	**Niveau Local (Paysan)**
La connaissance écologique	How can we ensure intellectual property rights over resources? How can we integrate local knowledge and scientific knowledge for better management? What ecological knowledge and information do we need to have to manage land use mosaics? How can we support research and development? How can we build trust with local people to share knowledge about medicinal plants?	What compensation can I get for the knowledge I have about natural resource management? How can I get access to scientific knowledge, to complement my own knowledge? How can I ensure intellectual property rights over my knowledge? I know about trees that provide an indicator of soil quality on my farm. There are messages that nature sends me (biological indicators) which helps me manage my land better. How can we make sure that outsiders respect our knowledge?
SERVICES	**QUESTIONS D'ÉVALUATION**	
	Niveau National (Conseiller de Politique)	
QUESTIONS RELIÉES		
Résilience/seuils d'écosystème (temporel et spatial)	How can I balance the desire for foreign exchange from timber with the desire to manage forests sustainably (have conserved forests)? How resilient is the forest margin?	How long can I stay on this piece of land?
Bien-être humain, vies soutenables, et réduction de pauvreté		How can we have secure access to significant cultural sites? How can I - as a vulnerable person (widows, pygmies, women) - have secure access to land for farming?

Annex 7e. Assessment questions for Peru

SERVICES	ASSESSMENT QUESTIONS	
	National Level (policy shapers)	**Local Level (farmers)**
PROVISIONING SERVICES		
Food, feed, fiber, etc.	How can coca be replaced? What are the most important goods? Who produces them? Which are the most profitable? What are the implications for food security (at the regional level)? How important are fish (riverine and aquaculture) and bushmeat in local income and regional food security? What is the value added in timber processing at the regional level? How important are these landscapes as a source of medicines? (Note: IIAP is researching antimalarial plants and other medicinals.) What are the main conditions and trends related to these goods at the forest margins? And what is the role of secondary forest in providing them? Is cattle ranching increasing or decreasing, and what does this mean for the remaining forest area? What are some of the international trends on timber and non-timber forest products that we should be aware of? How can we support industry (and others) to take advantage of these trends? How can our forest concessions structure support this? What are the best/most creative forest management options? What conflicts might arise by promoting 'restingas' (floodable areas) as agriculture land, since there are no clear property rights for these seasonally productive areas?	What are the immediate benefits I can get from the forests? How can we have year-round production in the floodable areas? Specifically, as indigenous people living in these areas, we are looking for crops that can grow despite flooding, to help plan year-round harvesting. What are some of the technical requirements of new products we are being introduced to, such as Camu-camu (Myrciaria dubia) and uña de gato (Uncaria tomentosa), both indigenous, to our area? How can we access capital equipment (e.g.. sawmill) and technical guidance, since we already have the wood? Most Amazon people rely on fish as a protein source rather than livestock or milk. Illegal loggers extract wood from native communities' forests and we can't protest since we need to go to the city and have no means to do it.

REGULATING SERVICES		
Carbon sequestration, including atmospheric regulation	What is CDM? How does it work? What is the potential for increasing C stocks here? Who benefits from these projects? What are the risks and opportunities presented by the Clean Development Mechanism (CDM) for forest conservation in Peru, and what role might the forest margin areas play in this scheme? (Current project GEA-CHEMONICS). Some effects of climate change are already being felt such as temperature increase and make difficult for crop planning (MINAG).	
Air quality	Not an issue here. (Aside from some concerns about smoke pollution from saw mills in Pucallpa.)	Burning pollutes the air and could also force the livestock to run away (Nicanor Pinedo neighbour).
Water supply	Could the rivers of the Amazon – especially in the foothills of the Andes -- be an energy provider (hydroelectric plants, etc) (UNU)? What are implications of agricultural chemical pollution for quality of supply of potable water? (thresholds for concern). Note: flooding is not a primary concern (communities are adapted)	Poisons (e.g. barbasco) applied for fishing to sweet waters are dangerous for us. “In the future there will not be fish for our children” (native community Panaillo). Shipibo communities move to areas where there is more fish availability (NONNETE).
Nutrient supply	Existence of a problem not established (but see soils below).	Which is the potential of the land for livestock? Only in few secondary forests bolaina (Guazuma crinita) and capirona (Calycophyllum spruceanum). grow successfully. This normally depends on what was planted before. Since there is no labor available to work on secondary forests, the farmers just let it grow, allowing the land to recover some nutrients. (CIFOR) and keep on getting inside the forests, therefore, creating more purmas (through S&B) (UNU).
Regulation of pests and diseases	Problem not established. Some interest in IPM for oil palm.	How could we protect poultry from depredation by other animals (“las boas se llevan a las gallinas”) or by flooding? The DEA ruined many crops when they fumigated to eradicate coca (AMUCAU/PROSEMA).
Erosion control	Existence of problem not established (see soils below).	We don’t believe it is good to cut all the forest, cut some parts and others not (Nicanor Pinedo).

RESOURCE BASE AND SUPPORTING SERVICES		
Soils	Is there a problem of soil degradation (e.g. soil fertility, erosion)? If so, how big is the problem? Where is the problem?	Which trees could be planted in poor soils? (AMUCAU) How could we restore the land (for agriculture)?.
Biological diversity, including genetic resources	How much does it cost to preserve biodiversity? How can we defend ourselves from biopiracy? How can the seed bank for agroforestry species which ICRAF and INIA are developing help us as we plan and implement reforestation programs?	
Ecological knowledge	What are the benefits to society and/or the economy from ecological knowledge? How can we better extend knowledge on oil palm and cocoa systems, as the production potentials of these crops are rarely reached? What opportunities are there for us to share views, lessons and experiences with those from other countries? How can we support better communication within the region on technical issues, e.g. rice varieties? There is limited extension support in the region, which aggravates the problem.2 Why do proven techniques and technologies not get adopted widely?	As rural people without formal education but with applicable technical agricultural knowledge, how can we ensure that our technical knowledge is validated by the government and others? What are some of the traditional and non-traditional ways our knowledge can be validated by others? What is the process of knowledge change and learning within our community, and how does it affect our ability to manage our lands? (local library, internet, story telling, drawings, etc). What technical support (and diffusion of knowledge) is available on oil palm and cocoa systems, as the production potentials of these crops are rarely reached? What opportunities are there for us to share views, lessons and experiences with others, both within the region (other farmers), and in other regions? How can we better facilitate neighbour-to-neighbour communication on technical issues, which is quite limited at present?

[2] Often NGOs like PROSEMA and REDPAL / NONNETE are conducting extension to the more remote communities (e.g. indigenous communities on the river) and farmers. Also, some stakeholders desired a stronger relationship with the research agencies. REDPAL/NONNETE run a local radio program about ecological topics which reaches far away communities e.g. Panaillo.

RELATED TOPICS		
Ecosystem resilience / thresholds (temporal and spatial)	How can spatial planning be implemented? Since the forest margins are such a dynamic environment, how can we develop plausible future scenarios that can help us plan the appropriate policy, technological and other responses for better poverty reduction and conservation? What are some of the major uncertainties we have to consider at the forest margins? What kind of strategies and interventions at a national level would support the development of a mosaic approach to land use planning at the forest margins? What is the impact of having – or not having - 'protected' areas' at the forest margins? In what ways do protected areas support or conflict with human wellbeing objectives? How would decentralization affect natural resource management? How could we integrate with other Amazonian departments for joint solution of common interests (e.g.. terrorism, coca) (UNU). How could we offer the farmers an 'integrated use' approach for their resources? e.g.. agriculture, forestry and use of residues for [compost] (IIAP)? What are the alternatives to slash and burn? How might conservation could be part of development?	What kind of changes could we expect to deal with in the future? What are some of the major uncertainties we have to consider? Some of us want to voluntarily leave coca production, what are the real opportunities of 'alternative crops' that US agencies (Chemonics, USAID) want to implement (e.g.. cotton)? How can we implement a mosaic approach to land use, and what does it mean at an individual farm level? Livestock is not our main activity but we would like to have it as 'bank account' (additional resources) that would help us to face economic/resources shock. How can we improve our food storage techniques so it lasts for longer (especially during crisis time)? Thresholds: If I cultivate palm, I don't have time for my farm (purma). I have to keep an area for self-subsistence. The time allocation to each crop will increase only if the crops are very valuable however, most of the species from secondary forests are of low market value.

Human well-being, sustainable livelihoods, and poverty reduction	How can we better understand market dynamics, especially market trends, to best allocate land at the forest margins (forest concessions, farming land, conservation, land tenure, tax relieves, forest certification…)? How can integrated natural resource management and environmental awareness best be included in strategic forward looking planning for the region and increased access to information? How can we best match the farmers' goals of improved economic well-being and food security with the economic development of the region as a whole, the latter which often favors larger enterprises? What are the key features of the socio-economic and governance context of the region? (benchmark site characterization) What are the main conflicts of interest at the forest margins? How do we link up with regulating institutions in Brazil (e.g.. IBAMA) to enforce the law and prevent illegal logging exports (INRENA)? How could we prevent illegal negotiations between migrants and native communities to have better access to land? What role might better communication infrastructure (telephones, internet, even roads) play in supporting economic development in rural areas at the forest margins? Would it merit the investment? How can we build the capacity of our young people, especially through education, to help the next generation have a wider range of options, besides agriculture?	How can we better respond to market trends? What are some ways we can gain better access to markets? What are some of the ways we can build up our capacity related to the marketing of products, especially within our local farmer organizations? How can we build the capacity of our young people, especially through education, to help the next generation have a wider range of options, besides agriculture?3 We don't need intermediaries, they themselves could come back to the village(s) to teach what they have learned. Which could be the mechanisms to do so, given that we have enough [intelligence/people] capacity? We aspire for them to become professionals (engineers or technicians) so that there would be a change" (Panaillo and AMUCAU/PROSEMA). We need an integrated project of health, education, and cooperative schools. How can we get basic health services? A 'medical post' in the village? and proper nutrition? How can we improve fishing/ poultry production? What is the impact of regionalization/decentralization for our farming and rights/land tenure? And globalization? How can we make best use of these trends? Many organizations have not achieved their goals so we don't trust them (AMUCAU/PROSEMA). Family work is the foundation for success, for moral support and labor (AMUCAU). Handicrafts could be a way of one of many livelihood options, but where are we going to sell the products, to whom if we are so far from the market or alternatively, how to bring

[3] Young people are taking business courses, information technology, English classes and the like in training for a more 'urban' career path or to run businesses in the community e.g. tourism. On the other hand, there is an expressed need for technical training so that young people could come back to the community and support local resource management. Ultimately, this is tied to the broader challenge of providing young people with an opportunity to choose their own future, be it rural or urban, in farming or teaching. However, most of the young people who leave to study don't come back since jobs are (easier) found in the city, especially if other family members live there already. For those native peoples who follow agricultural related professional careers, it is easier to get a job and therefore more difficult to come back to the village. They expressed an urgent need for scholarships.

Human well-being, sustainable livelihoods, and poverty reduction	How might training of those in the forest margins in non-agricultural economic sectors such as tourism, industry and services have an effect on the poverty reduction and deforestation? What is the impact of regionalization on the forest margin areas, in terms of resource use / management and social structure? What is the impact of globalization? How can we make best use of these trends? How would we have access to funds for research and how do we improve the communication of results at the policy level? How can we improve the trust of farmers to work on new projects? How can we ensure that power dynamics are addressed (and we are convincing the right people) for wider adoption of results? How do we assure empowerment works for the farmers for their own development? What is the potential role of industrialization for the Amazon region? Particularly for the lowland forests?	the market to us?

Interesting quotes:
"Necesitamos crear una cultura de preservación del bosque (conservación), el día que la madera se acaba, esta ciudad (Pucallpa) desaparece" (Ricardo Woolcot, 2003).
"Peru is a very studied country, what is failing are its institutions and organizations" (F. Sagasti).

Annex 8. Procedures for ASB-MA ecosystem goods assessment

Purpose:
Assessment of conditions and trends in the production of ecosystem goods for the tropical forest margins focusing on the following questions derived from our user needs consultations:

1. What are the major ecosystem goods from the tropical forest margins?
2. In which forest and forest-derived land uses are they produced?
3. What share of national production of these goods comes from the tropical forest and forest-derived land uses?
4. What are trends in land use, production, and yields?

Processes & steps:
Complete a "goods checklist" and a "production matrix" to identify sub-national data needs for ASB sites in the tropical forest biome:

1. T Tomich, K Sebastian, and C Palm design goods checklist and production matrix, specific instructions, and overall procedures; check for consistency. COMPLETE
2. Send these materials to SJ Velarde, D Timmer, Sara Scherr, and Steve Vosti by June 21, for their review. COMPLETE
3. Sandra, Dagmar, Sara and Steve send any comments to Kate Sebastian by 6 July. COMPLETE
4. Kate to incorporate suggestions by 8 July. COMPLETE; In response to the comments received the 'goods checklist & production matrix' was simplified to only include the production matrix, plus descriptions of the land use systems and categories of goods. The production matrix can be summarized at a later time into a goods checklist.
5. Joyce Kasyoki confirms participants for Goods Workshop and establishes listserv for Goods Group. (Lead authors, Contributing authors, National and Regional facilitators) by 8 July. COMPLETE
6. Kate sends production matrix, and overall procedures to Contributing Authors, National and Regional facilitators by 12 July.
7. Contributing authors to make comments/questions on production matrix and overall procedures to Kate (and copied to listserver) by 19 July (any needed revisions will be shared with the group as they are identified).
8. Contributing authors complete production matrix by 30 July and send to Sandra Velarde (and Kate Sebastian). Please take these a step at a time. We anticipate that the production matrix should not take more than 3-4 hours to complete (perhaps much less), including updating, assembling sources, and filling in estimates for production shares and production values in cases where more than one meta land use accounts for more than 10% of production of a specific good.

Create "data template", provide sub-national data to contributing authors, and compilation and critical assessment of secondary data by contributing authors.

1. Kate Sebastian to adapt existing IFPRI template for ASB-MA needs to accommodate production— and (if appropriate) area and yield—data, codes for specific goods (based on FAO and new categories), a worksheet for each goods category and separate files for national, sub-national, benchmark levels by July 15.
2. Kate to get list of goods to Tom in order to check list of goods according to appropriate categories and inclusiveness by 1 July. COMPLETE
3. Kate to provide Sandra with sub-national production data for 6 ASB countries with basic instructions by 19 July.
4. Kate to draft instructions for contributing authors for completing the templates (and summary sheet indicating data sources, critical assessment of data quality and completeness, and data gaps)— including data sheets for non-renewable resources— and send to Sandra/Tom/Cheryl by 23 July.
5. Kate to provide list of administrative units and area shares within the biome/ecoregions (as part of the data templates) by 23 July.
6. Sandra (in consultation with Kate before 23 July) to convert FAO format data to ASB-MA format by 2 August.

7. Sandra (in consultation with Tom) to identify relevant national and sub-national data and delete irrelevant data (referring to production matrix and lists of administrative units within the tropical forest biome) and revise instructions by 12 August.
8. Sandra to edit each template and distribute instructions and templates to contributing authors by 23 August.
9. Contributing authors to send comments/questions on instructions and data templates to Kate and Sandra (and copied to listserver) by 31 August (any needed revisions to the procedure will be shared with the group as they are identified).
10. Contributing authors work to complete template and their critical analyses of available data (quality, coverage, and gaps) and bring these to Nairobi meeting 4 – 7 October. Top priority is to compile data for administrative units roughly corresponding to ASB benchmark sites and for states/provinces containing ASB benchmark sites. If national level data and/or data for other states/provinces within the tropical forest biome (as indicated in the templates) are easily available, please compile and bring those too.
11. Contributing authors to collect: food balance sheets for their respective countries at the national level (and relevant smaller administrative units, if available); and any other relevant secondary data sources (references, articles, statistics) that will help provide a comprehensive picture of the benchmark site in regards to the production of goods. Contributing authors should be prepared to bring these data sources and references to the Nairobi meeting.

Integration of goods data and ASB meta land uses, spatial analysis, and assessment of goods produced within the tropical forest biome.

1. Kate to define the landscape mosaic areas based on 2000 land cover data by 3 Sept.
2. Kate to prepare and send letter indicating spatial data/unit desires: e.g., Land cover/land use (target year 2000), administrative units, deforestation areas, shifting cultivation/slash-and-burn areas, soils; by 19 July.
3. Contributing authors comment/question and indicate availability of data to Kate from 19-28 July.
4. Contributing authors compile and send spatial data to Kate by 27 August.
5. Kate works with contributing authors on preliminary spatial analysis from 31 August – 4 Oct.

ASB-MA Workshop: Scaling up the goods Assessment – Nairobi 4 - 7 October

1. Each contributing author presents their "production matrix", and critical analyses of the available data, their quality and coverage, and gaps; and trends for goods in area, production, and (if appropriate) yield.
2. Review "production matrix" for current land use percentage of production and estimate circa 1970-1975 land use types and production shares for specific goods as indicators of ecosystem condition (degradation/restoration patterns); document sources.
3. Prepare zero order draft of summary table (modeled on PAGE Agroecosystems study).
4. Kate and contributing authors present findings from preliminary spatial analysis including comparison of 'top-down' pantropic analysis of landscape mosaics with 'bottom-up' meta-land use mosaics from ASB benchmark sites. Participants will collaborate to identify patterns or indicators of landscape mosaic structure across sites and to critically assess the definition of landscape mosaics at the pantropic scale. Participants also will identify any other persons/resources that could be important for the spatial analysis.
5. Develop plans and written protocol for 'scaling up' from benchmark to state/province, ecoregion, biome, national, and international levels.
6. Kate to provide contributing authors with available spatial data (e.g. coarse resolution land cover, population) at the biome/ecoregion level.

Post-workshop tasks

Collaboration in analysis and assessment of goods produced at tropical forest margins within ASB ecoregions relative to quantity supplied at regional (state, province), national, and (possibly) international levels in order to 'scale up' ASB land-use analysis of production of goods to policy-relevant scales, namely regional (state, province), national, and possibly international levels (for internationally-traded commodities).

Spatial analysis for selected indicators or goods produced in land use systems/landscape mosaics at tropical forest margins, as a major input to ASB-MA assessment of conditions and trends. Trend analysis of land use, production, and yield as indicators of ecosystem condition and trends in sustainability.

Annex 9. ASB-MA plan for 'Responses' assessment (draft)

Note on status and next steps: work on responses will begin after completion of conditions and trends assessment and scenarios training.

Bold = responses aimed at balancing tradeoffs

***Italics* = narrower responses**

Topic	Assessment question(s)
Responses	How can tropical countries strike an equitable balance between local and national development and global environmental concerns?
Technological change in agriculture or forestry	What are the alternatives to slash and burn agriculture? What are the alternatives to burning? Can better soil fertility management simultaneously reduce poverty and conserve tropical forests? Can intensification of land use simultaneously reduce poverty and conserve tropical forests? (Note: this last question is the intensification hypothesis from ASB Phase II.)
Sectoral credit programmes (agriculture and forestry)	What are the environmental effects (via deforestation) of subsidized credit for agricultural production activities? How could we best spend a portion of the substantial World Bank loan to Brazil for the development and management of the forest sector to benefit smallholders and the environment?
CBD & other international agreements	What are the implications of having ratified the Convention on Biological Diversity? What can we practically (and realistically) do to implement it? How can tropical countries significantly reduce loss of biodiversity by 2010, as agreed at the World Summit on Sustainable Development?

Habitat protection & other conservation-focused strategies (possibly in comparison with the following on multiple use management)	How much forest cover does a tropical country need? What role do the forest margins play? What role does instability of forest cover at the margins play? How can we deal with national forest cover targets (of 25-30%)? (also in landscape restoration) What is the impact of conservation strategies on local livelihoods? (also in human wellbeing) What constraints should be placed on land use, especially in mountainous areas? What are the roles of *ex situ* (in addition to, and in contrast to, *in situ*) conservation strategies, especially in countries facing rapid change in the state of their biological resources?
Multiple use management / segregate or integrate production of goods and services	What practically do 'ecosystem management' or 'landscape management' mean? What is my role (as a farmer) in biodiversity management? How can I manage my fishing, hunting and gathering to be more sustainable? What is the potential for increasing the value of biodiversity at a local level? How can I have bushmeat species in my fallow? How can management of forest and tree components of mosaic agroforestry landscapes for commercial production of NTFPs be developed that would both improve local incomes and help assure their longer-term maintenance in the landscape? How can local land use zoning be developed to meet the needs of both local livelihoods and environmental sustainability? Can agreements on local land use zoning provide a basis for formal recognition of land use in mountain watersheds? How could local land use zoning agreements be monitored for compliance in a manner that insures transparency and accountability? How can local land use zoning, local resource/ watershed management networks, and partnerships with forestry agencies assure protection of critical watershed forest, parks and wildlife sanctuaries? Which environmental service issues are best managed by different scales/ configurations of social organization?

Land & tree tenure reform	Creating fair and effective policies and institutions to govern land and tree tenure is a prerequisite for eradicating poverty and protecting the environment – but how to do it? (See ASB Policybrief #2)
Property rights over biological resources and indigenous knowledge	Who "owns" biological resources? What system of property rights over biological and genetic diversity is required to ensure that these resources are recognized, protected, used and rewarded, as well as that access is guaranteed? How can we secure property rights over genetic resources? What are some mechanisms for sharing access to biological resources with ethnic minorities? Who represents minority groups, especially nomadic communities (e.g., *Orang Rimbo)*, in negotiations about access to and use of biological resources? What system of intellectual property rights is required to ensure that local knowledge is recognized, protected, used and rewarded? (For example, "I know about trees that provide an indicator of soil quality on my farm. There are messages that nature sends (biological indicators), which help me manage my land better. How can we make sure that outsiders respect our knowledge?") What compensation can local people get for the knowledge they have about natural resource management?
Price policy, marketing and trade policy reform	What are the policy and institutional barriers to marketing products from the tropical forest margins? Should these be addressed? If so, how? (See ASB Policybrief #3) How can local communities better respond to market trends? What are some ways local communities can gain better access to markets? What are some of the ways local communities can build capacity to market products? How can we help small-scale farmers meet product quality standards? What can we do to better understand and manage the effects of international / regional integration?
Infrastructure investment Note: link to driving forces	What are some of the practical ways we can reduce the environmental consequences of roads? Are there lessons that can be shared with other countries regarding roads-deforestation links?

Incentive schemes for environmental services (including RUPES)	How can we identify and measure the environmental services provided by forests and alternative land use systems? How could we use this information in our Brazilian federal government programme (in 17 Amazonian sites) to develop mechanisms for compensating individuals / smallholders managing these forest and alternative systems? Who would pay for the compensation? What incentives are necessary for effective establishment and maintenance of filter strips and conservation farming practices? What about other types of interventions? If distribution of costs and benefits are not seen as equitable, what types of rewards (e.g. tenure, services, subsidies, payments) could improve equity and incentives? What policies and institutional arrangements would be required for these reward mechanisms to work effectively? (See AgEE concluding chapter.)
Carbon storage / Clean Development Mechanism (CDM) as a specific example of an incentive scheme for environmental services	What potential is there in international carbon markets to complement national programs for compensating smallholders for environmental services? What is the relationship between carbon trading and economic growth? Would it benefit us? How much money can we make from carbon trading? What is the CDM (Clean Development Mechanism of the Kyoto Protocol)? How does it work? Are there opportunities presented by CDM for funding forest conservation? What role might the forest margin areas play in CDM? Who benefits from these projects? Who has the expertise to evaluate carbon stocks in different land use systems (or how can we acquire it)? How do you implement a CDM project? Who would be the implementation agents for this kind of system? How could we manage the revenue from trading? How do other countries do it? What is the experience of other developing countries? When will it start? How long can it last? Is this just a passing fad? What are you paying us for? What is the risk of taking this money? Is there a hidden agenda? Are outside people buying our forests? What is the government doing about CDM? Who are the vested interests? Can I trust this? Who controls the money, the rules of the game, who will monitor? If it succeeds, what will happen to me? If it fails, what will happen to me?

Landscape restoration	How much forest cover does a tropical country need? What role do the forest margins play? What role does instability of forest cover at the margins play? What role could restoration play? How can we deal with national forest cover targets (of 25-30%**)**? (also in habitat protection / conservation strategies) How can Rp 10 trillion (approximately 1.25 billion USD) of national reforestation funds be spent over five years in a way that improves environmental services and livelihoods, that is politically popular at the district level and that builds capacity for sustainable development at the local level? What techniques are available for restoring soil fertility in degraded lands, including degraded pastures and *Imperata cylindrica* grasslands? Are they profitable? What are some of the improvements in pasture and livestock management which have the potential to dramatically improve pasture productivity, extend pasture life and increase the profitability of cattle operations? Is there any way we can take care that this improved pasture productivity limits (rather than increases) pasture expansion? How effective are vegetative contour strips in reducing erosion losses on agricultural fields? What is the effect of 'reforestation' on water supply and other watershed functions? (Note BNPP tech note E exists.)
Education, training, access to information (building human capital)	How can we build the capacity of our young people, especially through education, to help the next generation have a wider range of options, besides agriculture?
Negotiation support / linking science, policy & civil society (building social capital)	How can we integrate local knowledge and scientific knowledge for better management? In situations that are changing quickly, how can the learning process to rapidly update local knowledge be supported? How can local people get access to scientific knowledge, to complement their own knowledge? How can upstream and downstream villages of multiple ethnic groups organize themselves to better manage local sub-watersheds?
Negotiation support: empowerment through measurement	Can communities in local sub-watersheds conduct systematic monitoring of the watershed services they provide? If so, can these local sub-watersheds organize themselves for overall monitoring and management of larger river sub-basins and basins? (See ASB Policybrief #7)

Annex 10. Draft template and chapter guidelines for ASB-MA assessment teams

1. Elements of the document:

Headline = title conveying the specific topic, perhaps add a catchy phrase.

Lead = the overall assessment question for this topic (in one sentence or a very few sentences), from the "Synthesis of ASB-MA Users' Needs".

NOTE: many of the current topics may need to be divided into multiple chapters.

Sidebar = strawman abstract (a paragraph or list of specific assessment questions)
Each chapter MUST contain a clear statement of a SINGLE PROBLEM and address it, including:

- **What is the problem?** What is the problem or issue for the information users' (target audiences') perspective?
- **Who cares?** Who are the users? Why should/do they care about the objective?
- **How can ASB data or methods help them (the users, usually policy shapers or policymakers) make decisions and act?**

Crosscutting responses to balance tradeoffs will be treated separately (in 2005). However, these chapters also MAY include a concluding section on specific responses. If so, the section on the specific response should address:

- What can policymakers do to REALLY affect the problem? Are the interventions technically, economically and socially feasible? If there is a lack of feasible 'interventions', what did/can ASB contribute?
- So what? What will be the likely impact of action (or inaction)? What are the options and attendant risks?

2. Scope of assessment:

Spatial: varying depending on the topic, but
at least the scale of synthesizing across ASB benchmark sites plus the Eastern Amazon associated site
preferably the WWF Ecoregions that include the ASB benchmark sites
if possible, the humid and subhumid tropical broadleaf forest biome

Temporal: varying according to data availability, but roughly 1970 (or earliest) to 2000 (or latest)

3. Procedure, indicating steps (and products such as maps, figures, etc)

Starting point for assessment:
What are the problems / issues identified in the assessment of **user needs** (in 3 above)?
What **indicators** have been validated and used by ASB or others?
Are these indicators **mappable**? If not, are valid proxies mappable?
What evidence is available on **thresholds**?

Resources for assessment:
Local knowledge and **policymakers' knowledge** (see MA guidelines for use of unpublished sources).
Scientific publications:
1) ASB reports and publications; ASB on-line publications database (www.asb.cgiar.org)
2) Relevant Millennium Ecosystem Assessment (MA) chapters
3) ASB Endnote bibliographic database
4) (possibly) SAfMA report for MA
5) Relevant peer-reviewed scientific publications

IMPORTANT PROCEDURAL NOTES:
(1) While it's good to have clear implications, a **range of options** often is better
(2) **Prescriptions are not appropriate**: beware of "must" and "should".
(3) While it's great to present real consensus**, avoid tendency to gloss over real differences**. It's fine to present encapsulated debates/controversies about real world implications.

(4) Address **methodological controversies** only IF they feed directly into interpretation of conditions or trends or IF they hold implications for use of data for decisions.
(5) **Sensitivity analysis** is far preferable to (spurious) efforts at precision. How does the range of uncertainty of results compare with important threshold levels?
(6) Use MA GUIDELINES ON **QUALITATIVE ASSESSMENT OF UNCERTAINTY**

4. Primary target audiences:

- national policymakers in ASB and non-ASB countries (different, more specific product is needed for impact within ASB countries)
- international agencies, including donors

NOTE: other more appropriate media will be developed (based on the assessment documents) for feedback to farmers' groups and rural communities.

Secondary audiences: media, academics

5. Unifying features:

- useful and legitimate (derived from and responds to user needs)
- credible (highest scientific standards)
- Integration of biophysical, agronomic, and social sciences
- Environmental plus development problems
- Humid tropics

6. Format:

- 2000-4000 words
- intensive use of graphics, maps to illustrate key points: typically at least one, no more than five

7. Products:

- Policybrief (stand alone, intermediate output)
- Chapter in the ASB MA assessment publication (to be combined later)

8. Review process: two parallel reviews will be arranged by the review editors, a technical review by a researcher with expertise on the topic and a national review by a user (often a colleague from a relevant national programme).

Annex 11. Workshop on scaling up the ASB Millennium Ecosystem Goods Assessment

Workshop proceedings, November 2004. 04th - 07th October 2004, Nairobi, Kenya

Edited by: Sandra J. Velarde, Kathryn Martell, Joyce Kasyoki and Tom Tomich

Introduction

Tropical forest margins are key sources of forest goods (products such as timber, food, and fuelwood). Despite their importance, little is known about the quantities produced or how they contribute to either local livelihoods or national economies. The Alternatives to Slash-and-Burn (ASB) programme is conducting an assessment of trends in the production, use, and value of ecosystem goods in tropical forest margins.

Partners from benchmark sites in Cameroon, Brazil, Peru, Indonesia, Thailand, and the Philippines have joined the Global Coordination Team in Nairobi for an ASB Goods Assessment Workshop (4-7 October 2004). The purpose of this workshop was to identify major farm and forest products, and set a structural framework for quantifying key trends in their use.

This workshop is part of ASB's contribution to The Millennium Assessment (MA), an extensive study of the state of the world's major ecosystems. In this workshop, ASB partners have identified major goods for food security, human health, and local and national economies. Participants have then defined units of analysis, identified classes of goods that can be compared across sites, discussed data reliability and availability, and set feasible priorities. In the first days of the workshop, participants identified maize, rice, cassava, and bananas as goods that are important at sites spanning the tropics. Case studies will be useful for categories of goods – such as fruits, bushmeat, and medicinals – that are so diverse they are difficult to compare across sites.

Partners have returned to their home countries and institutions prepared to gather the necessary data for the goods assessment. Their findings will help revise research priorities, strengthen policies, and increase the relevancy of regional projects.

We would like to acknowledge the efforts of all participants and our office assistant Catherine Kimengu for helping us with the workshop logistics, Rachel Rumley for her support with this introduction and our main donor for this meeting, the Millennium Ecosystem Assessment.

-The Editors

ASB Goods Workshop Notes

This assessment should produce value within the institutions, and fit with institutional priorities. This should be a product that is immediately useful to the organisations themselves.

During a 3 day workshop, we selected 15 goods to be analyzed cross-site. We decided that spatial scaling-up needs to be done in a case by case basis and a timeframe to further explore this activities was proposed.

Overall objectives: Assessment of **conditions** and **trends** in the production of ecosystem goods for the tropical forest margins.
Focusing on the following questions:

1. What do we mean by the "**tropical forest margins"**? [links between ecoregions and **administrative units** clarified for goods assessment for each site; more to be done to link ASB matrix land uses and ASB benchmark site landscapes]
2. What are the **major ecosystem goods** from the tropical forest margins?
3. In which forest and forest-derived landuses are they produced? [based on the production matrix – when to complete? How?]
4. What are trends in land use, production, and yields? [protocol for measures and indicators this afternoon]
5. What share of national production, food supply, exports of these goods comes from the tropical forest and forest-derived landuses? [protocol for measures and indicators]
6. For internationally traded goods, what are trends in relevant world markets? [protocol for measures and indicators]
7. How can spatial data be used to 'scale up' the assessment? [protocol to 'scale up' from ASB matrix land uses, to ASB benchmark site landscapes, to global data]
8. How many people depend on these systems for their livelihoods?
9. Are these plans realistic? What timeframe is feasible?
10. Other key questions on the goods assessment or the process?

We have outlined one strategy to capture major goods, and another to capture diversity.

The 3 proposed **broad categories** of goods are:

- food & feed (from plants)
- food (from animal sources)
- non-food products
-

These goods contribute in different ways in different places to:

- food security
- human health
- local livelihoods
- national economy
- environmental impact

Below are the discussion and action points raised during the meeting, of relevance to all participants and cross referred with the material distributed and produced during the workshop. Following them, you will find general notes from the meeting, including expectations, some "fears", definitions and questions raised. Specific notes are available per country from: s.velarde@cgiar.org.

Full Workshop documentation is available on-line at www.asb.cgiar.org/ma

ASB Goods Workshop Notes	
Discussion / Process	**Action (all participants unless indicated)**
General Process & Discussion Points	
→ **everything was done as whole group** (13 people): this process seemed to work very well, not only for keeping the group focused but also by allowing all participants to learn about goods, land use systems, and issues in the other regions - Reality check: clear priorities, realistic expectations, users → whole process is supposed to be **driven by usefulness, also utility for collaborators** - how this will feed into **scenarios** training workshop, very useful to know production trends when doing scenarios assessment - domestication: how do goods cross boundaries? Ex from harvested from primary forest, to being cultivated in secondary forest, to being grown in home gardens, to plantations…	1. identifying "what is a Tropical Forest Margins" should be part of protocol for each place 2. strongly urged participants to publish available results first elsewhere (adds credibility to the MA) 3. participants to document student projects and involve students in this exercise 4. **invite institutions** to participate in whole process, that includes **scenarios** (show how this can be a tool to feed into scenarios and for other future use) 5. organize briefing session for ambassadors here in Kenya 6. we are doing an **assessment** of available information; guidelines exist for helping us report the degree of confidence we have In the available data. See: *MA Procedure for Using Non-Published/Non-Peer-Reviewed Sources* and *MA Guidelines for Handling Uncertainty (attached).*
Scope and Scale File: Geographic scope and units of reporting of ASB MA Goods.doc (attached)	
- **Scale(s) of goods analysis** – what is the production domain: ecoregion or admin unit for level 1? Benchmark site, admin unit, in between? - went through each region / country and discussed whether administrative boundaries line up with ecoregion boundaries for the goods assessment - defined Level 1, Level 2, and sub-national units to be used for all countries - statistics are not published for the forest margins: are published for administrative units - for the scale up analysis, we need to consider what is	**1. decided to use administrative units since they roughly correspond to ecoregions being used** (exclude non-biome provinces of region, or when they are not appropriate, e.g. savannah areas in Brazil) - acknowledge that this does not really work well for Brazil – Para nor for Peru but is within reason Level 0 Country data Level 1 One admin level below the nation (e.g., departamentos/regiones in Peru, estados in Brazil, etc.)

adoptable technologically and culturally feasible, taking into account the population and society and their demands, social context.	Level 2 Two admin levels below the nation (e.g., Microregions or even Municipalities of Brazil, Provinces in Peru, etc.)
Goods selection Files: aggregatematrix.xls (attached), Goods assessment selection.doc (attached)	
created chart as a group, each country / area representative listing most important goods in each category - goods categories – statistics available may determine categories used (e.g. forestry stats are very different in the different countries) - acknowledge that units for fruits and vegetables are a problem - units for livestock – heads (herd size) or meat production (both if data available) - **invisible production** of milk and cheese (all consumed locally but animal is sent elsewhere for slaughter) – important for food security in some countries - maize and cassava are both *food* and *feed* - animal feed category, distinction between pasture and grassland is possible using landscape level work at benchmark sites, but is not available at state or national level - rice, need to distinguish growing zone (upland or floodplain) due to big differences in productivity (perhaps by looking at monthly data, and distinguishing by time harvested) - differences in how same product is cultivated in different areas, e.g. oil palm in Cameroon (backyard) compared to Amazonia (large scale estates) these are goods that specifically contribute to: - food security - human health - local livelihoods - national economy - environmental impact	divided into 3 broad categories for the assessment: food & feed (plant) food (from animal sources) non-food → goods listed in each category account for 80% of production in the category → groundnuts placed in pulses (not in nuts) if are consumed and not just used for oils → fish includes seafood and shellfish → for some goods (example fruits and vegetables) it was decided it is more important to focus on diversity and sustainability instead of total quantity or value - initially listed many goods in each category, then, as a group, refined the list down and **created two groups of goods that we will assess**: **1. cross-cutting goods** – important in all areas, these were chosen for cross-cutting *quantitative assessment* that will be comparable across regions and countries and **2. goods for specific case studies --** chosen for some goods (example fruits and vegetables) where it seems more informative to focus on diversity and sustainability instead of total quantity, case studies will be largely *qualitative* → will not do eggs, too difficult, except case study in SE Asia where they are very important → distinction between pasture and grassland for <u>feed</u> removed due to the lack of data classified as such → Conditions and Trends periods (to be <u>updated</u> by each team) Target: Condition 2000 (avg 1999-2001); Trend 1980(avg 1979-81), 1990 (avg 1989-91)

Final selection of 15 cross-cutting goods was based on: - data availability - institutional priority - real need - realistic timeframe expectations - usefulness (to partner institutions)	Peru 2000 (avg 1999-2001) 1980?, 1990 (avg 1989-91) Brazil 2000 (avg 1999-2001) 1980?, 1990 (avg 1989-91?) Cameroon 2000 (avg 1999-2001) 1980?, 1990 (avg 1989-91) Thailand 2000 (avg 1999-2001) 1980?, 1990 (avg 1989-91) Indonesia 2000 (avg 1999-2001) 1980?, 1990 (avg 1989-91) Philippines 2000 (avg 1999-2001) 1980?, 1990 (avg 1989-91)
Case studies Allocation of case studies → these were decided considering data availability (quantitative and qualitative), but more importantly the time commitment - problem with case studies is how to look at trends	→ each participant whether they have access to the expertise to conduct the case studies within the timeframe outlined by the group → all participants will do medicinals Potential case studies by country: **Cameroon:** fruit, bushmeat, fuel; if possible, vegetables, fibres **Thailand**: fruit, vegetables; if possible, fuelwood **Philippines**: fruit, vegetables, fibres; if possible, eggs **Indonesia**: fruit, fibres Western Amazon: fruit, milk **Brazil – Para** : fruit; if possible, fuelwood **Brazil – Acre**: bushmeat, fuelwood; if possible, fibres **Peru** – aquaculture, fuelwood; if possible, bushmeat
Data Selection and Collection	
Data Selection (general) - **availability and quality** of data differs depending on source, country, etc - key to keep track of contributors and data sources (including names of collaborators) - quality of information more important than consistency of time series (more important that each site has production data from same time as land cover data, than that all sites use the same data periods) - inconsistencies between FAO, IFPRI and national data - at site level, it is possible to link landscape with land use → land use typology	→ need to note why chose one source over another (e.g. FAO vs.another source) → identify sources (leaders, collaborators), also acts as a feasibility check → for the spatial analysis, the production data to use should be the one that closest match the land cover data → engage experts to review data to help with judgments on validity of data, and help identify gaps → identify gaps: through this process of putting numbers on goods, will see where data are

- recognizing where there are problems in the data e.g. sub-global assessment is an opportunity for groups with an understanding of land-use at a finer scale to inform (satellites and coarse data do not distinguish) For an overview of FAO National data: SummaryData.xls (attached) ProductionASB.ppt (attached)	inadequate or missing → important to include data and not just analysis in results sent to ASB
Cross-cutting goods	File: Summary Template Goods crosscutting.doc (attached)
Food & Feed (plant), Food (animal) - gather information from food balance sheets, FAOSTAT, national or other sub-national sources (see Indonesia Food balance sheet distributed during the workshop) - Kate Sebastian to provide information from CIESIN global population databases Non-food products: - Timber: natural, plantations; Industrial raw materials: Coffee; cacao; rubber; Spices: black and white pepper; cinnamon (Sumatra); Nuts: Brazil nuts (Brazil – natural & plantation) - data from FAO, IITO, USDA-FAS, and national / sub-national statistics	1. Cross-cutting data analysis 2. participants encouraged to publish assessment results at different levels
Case studies	File: *Summary Template Goods case studies.doc* (attached) and *Goods assessment selection.doc* (attached). Also provide **photographs** demonstrating diversity and / or changes in diversity. Credit for photographers. Indicate data and place of the photo.
Data sources: secondary sources at the national / sub-national levels, FAO statistics Food & Feed (plant)	inventory of types of fruits / vegetables produced at national / sub-national levels, (in humid forest biome if possible) Fruit (quantitative (where available) & qualitative / land use sources): Cameroon, Philippines, Indonesia, Thailand, western Amazon, Brazil-Para Vegetables (quantitative (where available) & qualitative / land use sources): Thailand; Philippines; Cameroon
Food (animal)	inventory of meat production Level 1, types produced in humid forest biome (wild fish, aquaculture, bush meat) Milk (quantitative): case study for Amazon livestock system

	Eggs (quantitative): case study for Southeast Asia (Philippines?) Aquaculture, wild fish: extraction/domestication – Peru Bush meat (quantitative & qualitative): Cameroon, Peru(?), Brazil-Acre
Non-food products (rattan, bamboo, other fibres; medicinals; fuel wood and charcoal)	inventory of types produced in humid forest biome purpose of use of medicinals changes over time if possible Rattan and other natural/planted fibers (quantitative & qualitative / land use sources) – Cameroon, Philippines, Indonesia, Brazil-Acre(?) Medicinals (quantitative (where available) & qualitative / land use sources) - Cameroon, Peru, Thailand(?), Philippines, Indonesia, Brazil-Para, Brazil-Acre(?), Brazil-Rondonia(?) Fuelwood & charcoal: (quantitative & qualitative / land use sources) – Peru, Cameroon, Thailand, Brazil-Acre(?), Brazil-Para(?)
Spatial Data File: *Summary Template Land Use.doc* (attached)	
Each team will assess the capacity of working with spatial data and link it to land uses to landscapes What do we mean by "mosaic" for each site? Landscape mosaic ⇨ Landcover? Land use – extraction, agricultural & agricultural mosaic areas. The **practical definition of mosaic** for the production data analysis varies across benchmark site and is indicated in *Geographic scope and units of reporting of the ASB MA goods assessment (attached)*. Presentations on spatial data and ecoregion databases are available at: *www.asb.cgiar.org/ma* : – Global Spatial Data: octmtg_KS_global_spatial_data.ppt – Scaling up, link with production data: *Octmtg_KS_spatial2.ppt* – wwf_ecoregions.dbf, wwf_ecoregions.sbn, wwf_ecoregions.shp – asbma_site_ecoregions.avl	1. Kate Sebastian to distribute datasets to participants 2. participants will send digital data back to Kate 3. participants will find best land cover case studies **4. each country to complete own institutional information** (e.g.. Scale of operating units, tenure, migrants or settlers, ethnic groups) 5. add fish ponds systems in land use form

General notes

1. Participant's expectations

- be very clear in what we can do (within constraints of time, data, etc)
- have fun!
- exchange information, learn about other benchmark sites; how do they interact?
- identify gaps in data / knowledge
- learn more about ASB
- get an idea of importance of these margin sites / TFM regions and their contribution to production to the region / ecosystem
- what exactly is scaling-up?
- what is extrapolation?
- "evolving systematic creativity"

ASB's "hidden" agendas:

- link our work to a bigger picture
- show significance of ASB's work
- leverage $$ for further work (e.g. using figures such as X% of national food production comes from TFM)
- link to global datasets (especially at the landscape level)
- need & opportunity to address the link between environment and human well-being, and to develop indicators for it

ASB contribution to this exercise:
spatially & temporally explicit analysis of land use within sites
pattern in fragmentation – general parameters of different systems, e.g. a livestock mosaic system looks generally like this…

2. Fears
What could keep you from doing this work?

- information gaps: will contribution still be valuable in light of these gaps?
- time and effort to pull this off – follow-ups – does anyone have it? Being realistic
- skills and technology gaps for contribution (e.g. lack of GIS expertise)
- inconsistent data: deciding which to use, what is most representative of what is on the ground?
- responsibility: this is outside scope of unit / organization, may not be a very high priority (finding time if supervisors have other priorities)
- no single agency can provide the necessary data

3. Questions & Points Raised (cards on wall)

- What is population and access to these areas? Where are these goods moving – are they for local use or international use? How does production relate to consumption?
- What forces (national, international) are changing these numbers – e.g. Government policies in Peru encourage people to move to these regions
- Within categories, relative weighting of *quality* of good (e.g. type of timber)
- Who is getting the profits?
- What *are* the Tropical Forest Margins?
- How / where are the margins moving (nationally, internationally)?
- What would you do with "perfect" data?
- Not all ASB benchmarks sites currently are "hotspots" for forest margins
- "landscapes" within multiple regions
- Social context & cultural values/ policies (e.g. adoption of agroforestry …)
- MA – who will use info? For what? What happens to these numbers?
- What to do about minerals?
- Invisible production

- NTFP : medicinals, oil palm, bushmeat, peach palm (pupunha), pet trade
- How to address issue when food for sale is not local, although that product is produced locally?
- What is scaling up?
- What are similarities / dissimilarities among sites?
- What is a Food Balance sheet?
- Relate landscape mosaics and livelihoods

4. Definitions

What is a Forest Margin?
We agreed that Forest Margins are ***forest and forest-derived land use systems*** in the biome*.
→ ecological definition of biome, defining from ecological perspective and not administrative

*Angel described a progression of land-uses:

crop
cattle
agroforest
secondary forest
primary forest (harvesting)
primary forest (no harvesting)

→ identifying "what is a TFM" should be part of protocol for each place: how far to go into the forest? How far to go into the cropland?

What is a biome?
→ potential rainforest area: defined by elevation, rainfall, agroecological zone

What is feed?
→ food given to animals

5. Questions from Spatial Data discussion
Questions yet to be answered:

1. How can the benchmark level spatial data be used in conjunction with the global level data?
   - as a form of 'ground truthing'
   - to correct/improve the global dataset
   - with the global dataset to define mosaics

How can the benchmark spatial data be used in conjunction with production data?

To link production to meta landuses
To map conditions or trends (using administrative unit)

2. How can the global level spatial data be used to define landscape mosaic?
   - Can this typology be used to link sites across the pantropics?
   - Is it just a way of reporting conditions in landscapes at a coarse level across the pantropics?

Priorities and Time Frame

General (ASB-GCO)

- Add list of meeting participants to collaborator list in MA status report
- Coordinate letter to contributors/institutions – reminder to participants
- Send FAO national Data including graphics

Goods Assessment	Landscape
November 2004	
15th: Each site to identify potential leaders and collaborators for the cross-cutting part of the goods assessment for the selected commodities **as soon as possible**	15th: Doug White to review with CIAT colleagues spatial analyses available for Brazil

30th: **Each site complete production matrix** for level 1 or 2 for current land use pattern for selected goods for cross cutting goods and case studies	
December 2004	
	1st: Each site to identify potential leaders and collaborators for the spatial assessment of land use and landscapes 15th: Each site to complete land use form (review, fill gaps, add fish ponds, complete institutions/scale).
January 2005	
15th: Each site to identify potential leaders and collaborators for the case studies part of the goods assessment for at least one of the case studies.	1st: Kate Sebastian to distribute spatial datasets.
30th: Each site submit data tables and *summary tables* (indicators & measures plus data and comments) for year 2000 (99-01 average) for food and feed (plant) cross-cutting goods assessment (analysis of conditions and trends and information status will come later)	30th: Each site, along with selected collaborators, to identify existing spatial analyses that can be part of the land use case studies (e.g. land use trend analyses)
February 2005	
28th: Email discussion to take stock of first exercises and to set priorities and time frame for the other goods assessments	28th: Identified collaborators communicate with Kate Sebastian regarding availability of spatial data

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Attachments

Geographic scope and units of reporting of the ASB MA goods assessment

(revised 6 – 10 – 2004)

ASB benchmark sites or affiliated sites.	WWF ecoregion(s)	Level 2	States or Provinces (Level 1 units)	Other sub-national units in the biome	Country (Level 0 units)	Other countries in the same biome / realm
Peru (Iquitos)	Iquitos Varzeas; Napo Moist Forest	Maynas	Loreto	Peruvian Amazon Add **Madre de Dios; San Martin; Amazonas; Huanuco**; *Pasco*; Junin*; Cusco*; Cajamarca** * exclude non-forest biome provinces	Peru	Amazon Basin / neotropical realm: probably not feasible to do
Peru (Yurimaguas)	Ucayali Moist Forest; Iquitos Varzeas	Alto Amazonas				
Peru (Ucayali)	Ucayali Moist Forest; Iquitos Varzeas (majority of production); Southwest Amazon Moist Forest (ASB scientists disagree with mapping of these classes)	Padre Abad & Coronel Portillo	Ucayali			
Brazil (Acre)	Iquitos Varzeas (majority of production); Southwest Amazon Moist Forest	Microregions: Senador Guiomar, and other microregions to be identified	Acre	Brazilian Amazon; Legal Amazon minus parts of Mato Grosso, Maranhao & Tocantins. (Legal Amazon includes all of Amazonas; Mato Grosso; Tocantins; Maranhao; Roraima; Para; Rondonia & Acre)	Brazil	
Brazil (Rondonia)	Madeira-Tapajós moist forests		**Rondonia** (excluding savanna municipios)			
Brazil (Para)	Tocantins-Araguaia-Maranhao moist forests; Xingu-Tocantins-Araguaia moist forests	Mesoregion: Northeastern Para (incl. 5 microregions)	Para			

ASB benchmark sites or affiliated sites.	WWF ecoregion(s)	Level 2	States or Provinces (Level 1 units)	Other sub-national units in the biome	Country (Level 0 units)	Other countries in the same biome / realm
Cameroon (Central / South)	Mainly Northwestern Congolian lowland forests; with portions of Northern Congolian forest-savanna mosaic and Atlantic Equatorial coastal forests		Central Province; and South Province	Other rainforest ecoregions in Cameroon (Cameroon minus North and Extreme North provinces)	Cameroon	Congo Basin / afrotropical realm: probably not feasible to do
Thailand (Chiang Mai)	Kayah-Karen montane rain forests		Chiang Mai	Upper Northern Thailand (Chiang Mai, Mae Hong Son; and parts of Chiang Rai, Lampang	Thailand	SE Asia / Indomalay realm (note excludes Australasian realm; Sulawesi and islands east of the Wallace line).
Indonesia (Sumatra)	Mainly Sumatran lowland rain forests; plus Sumatran montane rain forests; Sumatran peat swamp forests; Sumatran freshwater swamp forests		All provinces of Sumatra	Add 4 provinces in Kalimantan	Indonesia	
Philippines (Mindanao)	Mainly Mindanao-Eastern Visayas rain forests; with some Mindanao montane rain forests	Bukidnon; Misamis Oriental	All 6 regions of Mindanao (9-13 & ARMM)	Add Eastern Visayas	Philippines	

Bold means “essential, top priority”
Italics means “desirable, but optional”

Goods assessment selection

Which broad categories of goods?
Proposal:

- Food (plant)
- Food (animal) & Feed (for livestock)
- Non-food products

- Which selection criteria to use to select specific goods?
- *Proposal*: select goods that play a significant role in at least one of the following:
- Food security
- Human health
- Local livelihoods
- National economic role (including international trade)
- Environmental impact

Which specific goods for cross-cutting quantitative assessment?
Food & Feed (plant):
Grains: rice, maize
Pulses: pulse(s) accounting for 80% of pulse production
Roots and tubers: **cassava**
Fruits: banana, *citrus*
Oilseeds: soybeans, palm oil, palm kernels, coconut

(Notes: other fruits and vegetables: case studies; spices and nuts: listed under "non-food".)

Food (animal):
Livestock: cattle, chicken
Meat (where data available): b**eef, chicken**

(Notes: case studies for milk, eggs, aquaculture, wild fish, bush meat. Main feeds commodities (maize, cassava) included in foods, above. Fodder (grasslands, pasture) data not available.)
Non-food products:
Timber: natural, plantations
Industrial raw materials: **Coffee; cacao; rubber**
Spices: black and white pepper; cinnamon (Sumatra)
Nuts: **Brazil nuts** (Brazil – natural & plantation)

(Notes: case studies for rattan and other natural/planted fibers; medicinals; fuels.)

Goods case study topics: how, what and where?
Food (plant):
Fruit (quantitative (where available) & qualitative / landuse sources): Cameroon, Philippines, Indonesia, Thailand, western Amazon, Brazil-Para
Vegetables (quantitative (where available) & qualitative / landuse sources): Thailand; Philippines; *Cameroon*

Food (animal):
Milk (quantitative): case study for Amazon livestock system
Eggs (quantitative): case study for Southeast Asia (Philippines?)
Aquaculture, wild fish: extraction/domestication – Peru
Bush meat (quantitative&qualitative): Cameroon, Peru(?), Brazil-Acre
Non-food products:
Rattan and other natural/planted fibers (quantitative & qualitative / landuse sources) – *Cameroon*, Philippines, Indonesia, Brazil-Acre(?)
Medicinals (quantitative (where available) & qualitative / landuse sources) - Cameroon, Peru, *Thailand*(?), Philippines, Indonesia, Brazil-Para, Brazil-Acre(?), Brazil-Rondondia(?)
Fuelwood & charcoal: (quantitative & qualitative / landuse sources) – Peru, Cameroon, *Thailand*, Brazil-Acre(?), *Brazil-Para(?)*

Summary Templates for crosscutting data analysis

Food & Feed (plants) – crosscutting data analysis	
MEASURES AND INDICATORS ***(annual unless otherwise noted)***	**DATA SOURCES AND COMMENTS**
Land use sources (ASB meta-landuses: Natural forest, Secondary forest, Agroforest-complex multistrata, Home garden, Simple treecrop system-plantation, Food crop fallow rotation, Continuous Annual crops – upland, Continuous Annual Crops – irrigated, Pasture, Grassland, Inland water)	ASB-MA production matrix
Productivity – Level 1: Yields for specific land uses *(metric tons per hectare – per cropping season)*	Agricultural statistics/surveys
Production – Levels 0 & 1 and sub-national units: Crop area – harvested *(hectares)* Crop production *(metric tons)*	FAO & national/sub-national statistics. Production is unprocessed crops.
Imports – Level 0 *(metric tons)*	FAO, USDA-FAS & national statistics
Exports – Level 0 *(metric tons)*	FAO, USDA-FAS & national statistics
Animal feed – Level 0 & 1 and sub-national units (if possible) *(metric tons)*	Level 0: Food Balance Sheets (FAOStat or national source); other sub-national sources.
Consumption (food) – Level 0 & 1 and sub-national units (if possible) *(metric tons)*	Level 0: Food Balance Sheets; other sub-national sources. Consumption indicates processed and ready for human consumption. This is converted to calories & protein to calculate consumption per capita
Nutritional Value – Level 0: Calories, Protein *(per kg)*	Level 0: Food Balance Sheets &/or FAO; use national level for all levels.
Population – Levels 0 & 1 and sub-national units	National & sub-national statistics; CIESIN global population databases.
Consumption per capita – Level 0 & 1 and sub-national units (if possible) *(kg/person, calories/person/day & protein/person/day)*	Level 0: Food Balance Sheets; other sub-national sources.
Total calories and protein per capita per day (from plant & animal sources) – Level 0 Total calories and protein per capita per day from plant sources – Level 0	Level 0: Food Balance Sheets; other sub-national sources.
CONDITIONS AND TRENDS	**INFORMATION STATUS AND NEEDS**

Food (animal) -- crosscutting data analysis	
MEASURES AND INDICATORS	**DATA SOURCES AND COMMENTS**
Land use sources (ASB meta-landuses: Natural forest, Secondary forest, Agroforest-complex multistrata, Home garden, Simple treecrop system-plantation, Food crop fallow rotation, Continuous Annual crops – upland, Continuous Annual Crops – irrigated, Pasture, Grassland, Inland water)	ASB-MA production matrix
Livestock – Levels 0 & 1 and sub-national units *(heads)*	Agricultural statistics/surveys
Meat Production – Levels 0 & 1 and sub-national units *(metric tons)*	FAO & national/sub-national statistics. Specify the form of the product (e.g. carcass).
Meat Imports – Level 0 *(metric tons)*	FAO, USDA-FAS & national statistics
Meat Exports – Level 0 *(metric tons)*	Level 0: Food Balance Sheets; other sub-national sources. Consumption indicates processed and ready for human consumption. This is converted to calories & protein to calculate consumption per capita
Consumption (food) – Level 0 & 1 and sub-national units (if possible) *(metric tons)*	Level 0: Food Balance Sheets &/or FAO; use national level for all levels.
Nutritional Value – Level 0: Calories, Protein *(per kg)*	National & sub-national statistics; CIESIN global population databases.
Population – Levels 0 & 1 and sub-national units	Level 0: Food Balance Sheets; other sub-national sources.
Consumption per capita – Level 0 & 1 and sub-national units (if possible) *(kg/person, calories/person/day & protein/person/day)*	Level 0: Food Balance Sheets; other sub-national sources.
Total calories and protein per capita per day (from plant & animal sources) – Level 0 Total calories and protein per capita per day from animal sources – Level 0	
CONDITIONS AND TRENDS	**INFORMATION STATUS AND NEEDS**

Non-food products – crosscutting data analysis	
MEASURES AND INDICATORS	**DATA SOURCES AND COMMENTS**
Land use sources (ASB meta-landuses: Natural forest, Secondary forest, Agroforest-complex multistrata, Home garden, Simple treecrop system-plantation, Food crop fallow rotation, Continuous Annual crops – upland, Continuous Annual Crops – irrigated, Pasture, Grassland, Inland water)	ASB-MA production matrix
Production – Levels 0 & 1 and sub-national units (natural or planted; small holder or large scale, if possible): Timber *(cubic meters)* Non-timber *(metric tons)*	FAO, ITTO & national/sub-national statistics.
Imports – Level 0 Timber *(cubic meters)* Non-timber *(metric tons)*	FAO, ITTO, USDA-FAS & national statistics
Exports – Level 0 Timber *(cubic meters)* Non-timber *(metric tons)*	FAO, ITTO, USDA-FAS & national statistics
CONDITIONS AND TRENDS	**INFORMATION STATUS AND NEEDS**

Summary Templates for case studies

Food (plants) – case studies of fruits and vegetables	
MEASURES AND INDICATORS	**DATA SOURCES AND COMMENTS**
Level 1 Inventory of types produced in humid forest biome (fruits & vegetables); changes over time if possible	Secondary sources at the national/sub-national levels.
Level 1 or 2 land use sources (ASB meta-landuses: Natural forest, Secondary forest, Agroforest-complex multistrata, Home garden, Simple treecrop system-plantation, Food crop fallow rotation, Continuous Annual crops – upland, Continuous Annual Crops – irrigated, Pasture, Grassland, Inland water); changes over time if possible	ASB-MA production matrix
Level 1 or 2 use and distribution (home consumption; local, national and international markets); changes over time if possible	
Production – Levels 0 & 1 and sub-national units (where available) *(metric tons)*; changes over time if possible	Secondary sources at the national/sub-national levels. FAO & national/sub-national statistics.
Exports – Levels 0 & 1 and sub-national units (where available) *(metric tons)*; changes over time if possible	FAO & national/sub-national statistics.
Photographs demonstrating diversity &/or changes in diversity	Credits for photographers.
CONDITIONS AND TRENDS	**INFORMATION STATUS AND NEEDS**

Food (animal) -- case studies milk and eggs	
MEASURES AND INDICATORS	**DATA SOURCES AND COMMENTS**
Level 1 or 2 land use sources (ASB meta-landuses: Natural forest, Secondary forest, Agroforest-complex multistrata, Home garden, Simple treecrop system-plantation, Food crop fallow rotation, Continuous Annual crops – upland, Continuous Annual Crops – irrigated, Pasture, Grassland, Inland water); changes over time if possible Level 1 or 2 use and distribution (home consumption; local, national and international markets); changes over time if possible Production – Levels 0 & 1 and sub-national units (where available) *(various)*; changes over time if possible Photographs demonstrating diversity &/or changes in diversity	ASB-MA production matrix Secondary sources at the national/sub-national levels. FAO & national/sub-national statistics. Credits for photographers.
CONDITIONS AND TRENDS	**INFORMATION STATUS AND NEEDS**

Food (animal) -- case studies fish and bushmeat	
MEASURES AND INDICATORS	**DATA SOURCES AND COMMENTS**
Level 1 Inventory of types produced in humid forest biome (wild fish, aquaculture, bushmeat); changes over time if possible	Secondary sources at the national/sub-national levels.
Level 1 or 2 land use sources (ASB meta-landuses: Natural forest, Secondary forest, Agroforest-complex multistrata, Home garden, Simple treecrop system-plantation, Food crop fallow rotation, Continuous Annual crops – upland, Continuous Annual Crops – irrigated, Pasture, Grassland, Inland water); changes over time if possible	ASB-MA production matrix
Level 1 or 2 use and distribution (home consumption; local, national and international markets); changes over time if possible	Secondary sources at the national/sub-national levels.
Production – Levels 0 & 1 and sub-national units (where available) *(metric tons)*; changes over time if possible	FAO & national/sub-national statistics.
Exports – Levels 0 & 1 and sub-national units (where available) *(metric tons)*; changes over time if possible	FAO & national/sub-national statistics.
Photographs demonstrating diversity &/or changes in diversity	Credits for photographers.
CONDITIONS AND TRENDS	**INFORMATION STATUS AND NEEDS**

Non-food products – case studies of fibres, medicinals & fuels	
MEASURES AND INDICATORS	**DATA SOURCES AND COMMENTS**
Level 1 Inventory of types produced in humid forest biome (rattan, bamboo, other fibres; medicinals; fuel wood and charcoal) and purpose of use for medicinals; changes over time if possible	WHO & secondary sources at the national/sub-national levels.
Level 1 or 2 land use sources (ASB meta-landuses: Natural forest, Secondary forest, Agroforest-complex multistrata, Home garden, Simple treecrop system-plantation, Food crop fallow rotation, Continuous Annual crops – upland, Continuous Annual Crops – irrigated, Pasture, Grassland, Inland water); changes over time if possible	ASB-MA production matrix
Level 1 or 2 use and distribution (home consumption; local, national and international markets); changes over time if possible	Secondary sources at the national/sub-national levels.
Production – Levels 0 & 1 and sub-national units (where available) *(various)*; changes over time if possible	FAO, ITTO, CIFOR, INBAR, WHO & national/sub-national statistics.
Exports – Levels 0 & 1 and sub-national units (where available) *(various)*; changes over time if possible	FAO, ITTO, CIFOR, INBAR & national/sub-national statistics.
Photographs demonstrating diversity &/or changes in diversity	Credits for photographers.
CONDITIONS AND TRENDS	**INFORMATION STATUS AND NEEDS**

Summary Templates for Land Use systems

Meta land use systems	
MEASURES AND INDICATORS	**DATA SOURCES AND COMMENTS**
Ecosystems/biome - global level	WWF
Land cover – best available/finest resolution data at benchmark level (level 1 & sub-national) / target year is 2000 /80's and 90's if possible	GLC2000, LANDSAT, national and sub-national datasets.
Land use – extraction, agricultural & agricultural mosaic areas; best available/finest resolution data at benchmark level (level 1 & sub-national) / target year is 2000 /80's and 90's if possible	National and sub-national datasets.
% Tree Cover – global 1km data	UMD – VCF 2000.
Irrigated Areas best available/finest resolution data at benchmark level (level 1 & sub-national)	??
Deforestation - best available/finest resolution data at benchmark level (level 1 & sub-national)	National and sub-national datasets.
Protected areas - best available/finest resolution data at benchmark level (level 1 & sub-national) / target year is 2000 /80's and 90's if possible	WCMC, national and sub-national datasets.
Roads (primary) – best available/finest resolution data at benchmark level (level 1 & sub-national)	National and sub-national datasets.
Water bodies (rivers, lakes, swamp) - best available/finest resolution data at benchmark level (level 1 & sub-national)	IWMI, GIWA, National and sub-national datasets.
Soil – (USDA classification system) best available/finest resolution data at benchmark level (level 1 & sub-national)	National and sub-national datasets. National and sub-national datasets.
Soil degradation best available/finest resolution data at benchmark level (level 1 & sub-national)	Global, national and sub-national datasets.
Climate - best available/finest resolution data at benchmark level (level 1 & sub-national)	National and sub-national datasets. CIESIN; National and sub-national datasets.
Slope/terrain – level 1 (sub-national where available)	CIESIN; National and sub-national datasets.
Population density - 1km global dataset & national/sub-national level data	Consortium (?).
Population rural/urban distribution - 1km global dataset & national/sub-national level data	Agencies/Institutions, etc…
Poverty maps – global	Scientists, administrators, policy makers, etc..
Crop specific maps – if available - data at benchmark level (level 1 & sub-national)	
Expert opinion on meta landuse system locations.	
CONDITIONS AND TRENDS	**INFORMATION STATUS AND NEEDS**

Land use form

Benchmark site or affiliated site: Brazil – Para

Meta land uses	Specific landuse examples	Distinguish in fine resolution remote sensing? (yes / no)	Institutional information (e.g, scale of operating units, tenure, migrants or settlers, ethnic groups)
Forest extraction	Logging; NTFP: brazil nuts; medicinals; rubber; fibres; bushmeat; charcoal; firewood	yes for large scale logging	Large & small scale logging
Complex multistrata agroforestry	na		
Home gardens	Vegetables; fruit; medicinals; beans; poultry; cassava; ornamentals	yes in more densely populated areas	
Simple treecrop systems	Multistrata: brazil nut; coffee; cocoa; pepper; fruits; timber; peach palm; acai palm; pineapple; citrus; acerola; cupuacu; banana & many others Monoculture: palm oil; rubber; coconut; coffee; pepper; timber; banana; passion fruit; acerola	yes	
Crop / fallow systems	maize; cassava; cow pea; vegetables	yes (but not between continuous crops)	
Continuous annual cropping -- rainfed	Rice; maize; vegetables; cassava; beans	yes (but not between crop/fallow crops)	
Continuous annual cropping – irrigated	Papaya; vegetables		
Pasture	Natural: cattle Improved: cattle	yes	
Wetlands, rivers	Rice; vegetables; water buffalos; Cowpea; fish; shrimp; crab; maize; cassava	yes	
Others	Silvo-pastoral: cattle	no	

Land use form

Benchmark site or affiliated site: Brazil – western Amazon

Meta land uses	Specific landuse examples	Distinguish in fine resolution remote sensing? (yes / no)	Institutional information (e.g, scale of operating units, tenure, migrants or settlers, ethnic groups)
Forest extraction	Logging; NTFP: brazil nuts; medicinals; rubber; fibres; bushmeat; charcoal; firewood	yes for large scale logging	Large & small scale logging
Complex multistrata agroforestry	na		
Home gardens	Vegetables; fruit; medicinals; beans; cassava; ornamentals	yes in more densely populated areas	
Simple treecrop systems	Multistrata: coffee; cocoa; pepper; fruits; timber; peach palm Monoculture: rubber; peach palm; coconut; coffee; pepper; timber; banana	yes	
Crop / fallow systems	Upland rice; maize; cassava; beans	yes (but not between continuous crops)	
Continuous annual cropping -- rainfed	Rice; maize; vegetables; cassava; beans	yes (but not between crop/fallow crops)	
Continuous annual cropping – irrigated	Watermelons		
Pasture	Natural: cattle Improved: cattle	yes	
Wetlands, rivers	Cowpea; fish; maize	yes	
Others	Silvo-pastoral: cattle	no	

Land use form

Benchmark site or affiliated site: Peru

Meta land uses	Specific landuse examples	Distinguish in fine resolution remote sensing? (yes / no)	Institutional information (e.g, scale of operating units, tenure, migrants or settlers, ethnic groups)
Forest extraction	Large scale logging; small scale logging; medicinal; bushmeat	Large scale logging: yes	
Complex multistrata agroforestry	na		
Home gardens	Maize; greens; fruits; hot peppers	yes	
Simple treecrop systems	Cocoa; palm oil; bolaina (Ucayali)	yes	
Crop / fallow systems*	Cassava; maize; plantains; rice (upland); soy beans	yes	
Continuous annual cropping -- rainfed	na		
Continuous annual cropping – irrigated	na		
pasture	cattle	yes	
Wetlands, rivers	Greens; cowpea; maize; fish; rice; beans	yes	
Others			

Land use form

Benchmark site or affiliated site: Cameroon

Meta land uses	Specific landuse examples	Distinguish in fine resolution remote sensing? (yes / no)	Institutional information (e.g, scale of operating units, tenure, migrants or settlers, ethnic groups)
Forest extraction	Large scale logging; small scale logging; medicinal; bushmeat	Large scale logging: yes	
Complex multistrata agroforestry	Cocoa; palm oil	yes	
Home gardens	Maize; greens	yes	
Simple treecrop systems	Cocoa; palm oil	yes (but not distinguishable from multistrata)	
Crop / fallow systems*	Cassava; groundnut; maize; plantains	yes (but not from continuous annual crops)	
Continuous annual cropping -- rainfed	Cassava; plantain; tomato	yes (but not from other crops)	
Continuous annual cropping – irrigated	na		
Grasslands	bushmeat	yes	
Wetlands, rivers	Greens; tomato; maize; fish	yes	
Others			

Land use form

Benchmark site or affiliated site: Indonesia

Meta land uses	Specific landuse examples	Distinguish in fine resolution remote sensing? (yes / no)	Institutional information (e.g, scale of operating units, tenure, migrants or settlers, ethnic groups)
Forest extraction	Logging; NTFP; rattan; medicinal; benzoin	yes for large scale logging	Large & small scale logging
Complex multistrata agroforestry	Coffee; rubber; damar; cinnamon	no	
Home gardens	Vegetables; herbs; coconuts; banana; fruit; medicinals; ornamentals	yes in more densely populated areas	
Simple treecrop systems	Multistrata: coffee; cocoa; pepper; cinnamon; banana Monoculture: rubber; palm oil; coconut; coffee; pepper; cinnamon; clove; timber; banana	yes	Monoculture: large scale & small scale for rubber; coconut; palm oil; coffee; timber Small scale: pepper; cinnamon; cloves
Crop / fallow systems	Upland rice	no	
Continuous annual cropping -- rainfed	Rice; maize; vegetables; cassava; sweet potatoes; soy beans	yes	
Continuous annual cropping – irrigated	Rice; maize; soy bean	yes	
Grasslands	Cattle; goats	yes	small scales
Wetlands, rivers	Fish; shrimp; rice	yes	
Others	Sugar cane; pineapple	yes	Mostly large scale

Land use form

Benchmark site or affiliated site: Thailand

Meta land uses	Specific landuse examples	Distinguish in fine resolution remote sensing? (yes / no)	Institutional information (e.g, scale of operating units, tenure, migrants or settlers, ethnic groups)
Forest extraction	?		
Complex multistrata agroforestry	Miang tea	no	
Home gardens	Fruit; medicinals	yes	
Simple treecrop systems	Coffee; fruit	yes	
Crop / fallow systems*	Upland rice; cabbage; carrot; maize	yes?	
Continuous annual cropping -- rainfed	Rice; maize; soy bean; flowers & ornamental plants	yes	
Continuous annual cropping – irrigated	Rice; soybean; groundnut	yes	
Grasslands	Cattle	yes	
Wetlands, rivers	fish?	yes	
Others			

Land use form

Benchmark site or affiliated site: Philippines

Meta land uses	Specific landuse examples	Distinguish in fine resolution remote sensing? (yes / no)	Institutional information (e.g, scale of operating units, tenure, migrants or settlers, ethnic groups)
Forest extraction	Logging concession	yes	Large scale
Complex multistrata agroforestry	na		
Home gardens	Vegetables; fruits; medicinals; ornamentals	yes in more densely populated areas	
Simple treecrop systems	Multistrata: Vegetables; coffee; cocoa; fruits; timber Monoculture: palm oil; coconut	yes	Monoculture: large scale & small scale for coconut
Crop / fallow systems	na		
Continuous annual cropping -- rainfed	Rice; maize; vegetables	yes	
Continuous annual cropping – irrigated	Rice	yes	
Grasslands	Cattle	yes	Large & small scales
Wetlands, rivers	Fish	yes	
Others	sugar cane; Banana (drip irrigation); pineapple	yes	Sugar cane: large & small scale ; Large scale; small scale

MA Procedure for Using Non-Published/Non-Peer-Reviewed Sources

Because considerable materials relevant to MA Reports, in particular, information based on indigenous, traditional, or local knowledge or information about the experience and practice of the private sector, are found in sources that have not been published or peer-reviewed (e.g., industry journals, internal organizational publications, non-peer reviewed reports or working papers of research institutions, proceedings of workshops, personal communication, etc.) the following additional procedures are provided. These have been designed to make all references used in MA Reports easily accessible and to ensure that the MA process remains open and transparent.

1. Responsibilities of Coordinating, Lead and Contributing Authors
Authors who wish to include information from a non-published/non-peer-reviewed source are requested to:

a. Critically assess any source that they wish to include. This option may be used for instance to obtain case study materials from private sector sources for assessment of adaptation and mitigation options. Each chapter team should review the quality and validity of each source before incorporating results from the source into an MA Report.

b. Send the following materials to the Working Group Co-Chairs who are coordinating the Report:
- One copy of each unpublished source to be used in the MA Report
- The following information for each source:
- Title
- Author(s)
- Name of journal or other publication in which it appears, if applicable
- Information on the availability of underlying data to the public
- English-language executive summary or abstract, if the source is written in a non-English language
- Names and contact information for 1-2 people who can be contacted for more information about the source.

c. Information based on personal communication from individuals with indigenous, traditional, or local knowledge, or direct input as a member of a working group by an individual with indigenous, traditional, or local knowledge should be handled in the following way:

i. In situations such as local assessments where extensive use of local and traditional knowledge will be involved, the assessment must establish a process of validation for the findings as part of the application by the assessment to become a component of the MA. The features of such a validation process are described in Section 5.6.3.

ii. Metadata concerning the personal communication (e.g., names of people interviewed, dates and types of notes recorded, presence or absence of self-critical review notes by the researcher, sources of 'triangulation', etc.) should be made available to the Co-Chairs of the Working Group.

iii. Where an individual provides direct input of indigenous, traditional, or local knowledge as a member of a working group, the individual should provide the Working Group Co-Chairs coordinating the report the following information:
- Basis for knowledge of the particular issue (length of time living in the area, individuals from whom historical information was obtained, etc.)
- Names and contact information for 1-2 people who can be contacted for more information about the source.

2. Responsibilities of the Review Editors
The Review Editors will ensure that these sources are selected and used in a consistent manner across the Report.

3. Responsibilities of the Working Group Co-Chairs
The Working Group Co-Chairs coordinating the Report will (a) collect and index the sources received from authors, as well as the accompanying information received about each source and (b) send copies of unpublished sources to reviewers who request them during the review process.

4. Responsibilities of the MA Secretariat

The MA Secretariat will (a) store the complete sets of indexed, non-published sources for each MA Report not prepared by a working group and (b) send copies of non-published sources to reviewers who request them.

5. Treatment in MA Reports
Non-peer-reviewed sources will be listed in the reference sections of MA Reports. These will be integrated with references for the peer-reviewed sources. These will be integrated with references to the peer reviewed sources stating how the material can be accessed, but will be followed by a statement that they are not published.

Source: Millennium Ecosystem Assessment. 2002. Procedures for the Preparation, Peer Review, Approval and Publication of Millennium Assessment Reports. Millennium Assessment Procedures. Page 20-21.

On-line at: http://www.millenniumassessment.org/en/products.aspx : Policies and Procedures

MA Guidelines for Handling Uncertainty

Conclusions should be phrased in such a way to avoid statements of indifference that are not illuminating. Clear, precise statements with assessed confidence levels are preferable. In particular, Authors should strive to avoid using language that expresses indifference (change in either direction – increase or decrease – is equally likely) and then assign what amounts to an essentially meaningless "medium confidence" label to the conclusion.

In addition, the language of the text should be consistent with the level of confidence – specifically, avoid using double qualifiers that undermine confidence in the conclusion. For example, if words like could or might are included, then the implication in that the statement is very likely to be true and should not carry an indifferent "medium confidence" label; a "high confidence" label is more consistent with the language. If authors are uneasy about using anything but conditional statements, then they should either include no confidence level label or an appropriately high one, since the conditional language implies the statement is very likely.

It is suggested that the MA makes use of a single set of terms, developed for use by the IPCC TAR. As the assessment progresses, it will be critical to review these terms and the consistency with which they are applied by various writing teams. Consistency in the use of confidence descriptors is critical, and a clear way to assure this is to have a discrete quantitative scale such as that suggested below (Figure 8-2). Without such a discrete quantitative scale, there is strong experimental evidence that the same uncertainty words often have very different meanings for different people in different circumstances (e.g., Morgan and Henrion, 1990).

The scale in Figure 8-2 has been adapted from that suggested for use in the IPCC TAR. In this scale, the 0.5 confidence implies maximum uncertainty (for example, increase or decrease in a particular phenomenon is equally likely). Confidence of 1.0 implies that we are absolutely certain that a statement is true. Confidence of 0.0 also implies that we are absolutely certain, but this time we would be absolutely certain that the statement is false.

(1.00)
“Very Certain”
(0.975)
(0.975)
“High Certainty”
(0.83)
(0.83)
“Medium Certainty”
(0.67)
(0.67)
“Low Certainty“
(0.525)
(0.525)
“Very Uncertain”
(0.5)

Figure 8.2: Scale for Assessing State of Knowledge and Statement Confidence

A set of qualitative uncertainty terms is also proposed (see Figure 3). These can be used to supplement the five point scale and explain why a writing team may express high, medium, or low confidence in a particular finding. It is proposed to use this as a supplement rather than as an alternative because these qualitative terms do not always map well onto a quantitative scale, increasing the likelihood of inconsistent usage.

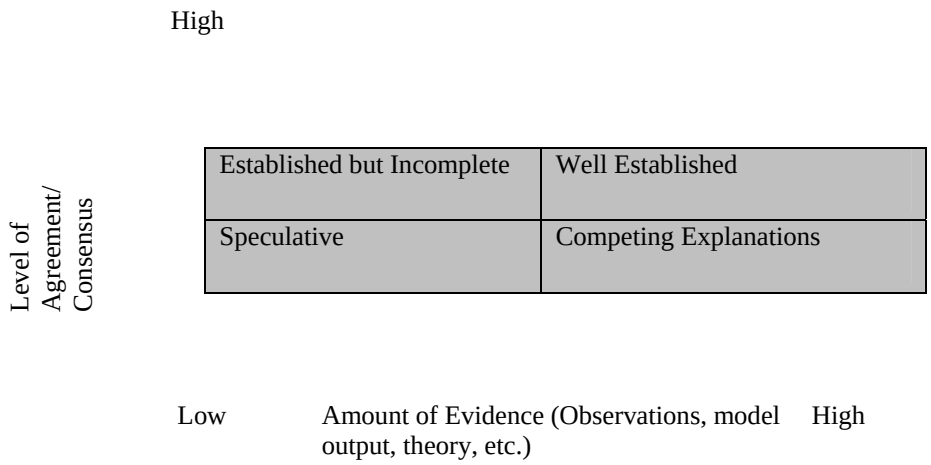

Figure 3: Supplemental Qualitative Uncertainty Terms.

Key to qualitative "state of knowledge" descriptors:

Well-established: models incorporate known processes; observations largely consistent with models for important variables; or multiple lines of evidence support the finding)

Established but Incomplete: models incorporate most known processes, although some parameterizations may not be well tested; observations are somewhat consistent with theoretical or model results but incomplete; current empirical estimates are well founded, but the possibility of changes in governing processes over time is considerable; or only one or a few lines of evidence support the finding

Competing Explanations: different model representations account for different aspects of observations or evidence, or incorporate different aspects of key processes, leading to competing explanations

Speculative: conceptually plausible ideas that haven't received much attention in the literature or that are laced with difficult to reduce uncertainties or have few available observational tests.

6. Prepare a "traceable account" of how the estimates were constructed that describes the writing team's reasons for adopting a particular probability distribution, including important lines of evidence used, standards of evidence applied, approaches to combining/reconciling multiple lines of evidence, explicit explanations of methods for aggregation, and critical uncertainties. In constructing the composite distributions, it is important to include a traceable account" of how the estimates were constructed.

Source: Reid W., Ash N., Bennett E., Kumar P., Lee M., Lucas N., Simons N., Thompson V. and Zurek M. 2002. Millennium Ecosystem Assessment Methods. Pages 72-73.

On-line at: http://www.millenniumassessment.org/en/products.aspx : MA Training and Capacity-Building Tools.