VI. Output 3.2. Development of policy & institutional options

This part of the report concerns **Project Output 3.2**, *development of policy interventions to facilitate the adoption of recommended land uses by (a) reviewing and analyzing policy options and recent institutional experiences relevant to the alternative land uses, (b) facilitating community participation schemes in selected pilot areas, and (c) organizing national workshops and consultations with relevant stakeholders and policymakers for policy and institutional reforms necessary for adoption of recommended land use alternatives.*

VI.1 Analysis of policy and institutional options

Many of the forces driving deforestation and natural resource degradation arise at the regional or national level. In particular, an inflow of migrants facilitated by road construction and driven by lack of economic opportunity elsewhere can swamp the effects of best-bet alternatives at the field-level. Profitability is a necessary condition for adoption of 'best bets' by smallholders, but is *not* sufficient by itself as a means to slow deforestation. Indeed, precisely because these alternative land uses are *profitable*, the 'best-bets' could have the perverse effect of accelerating deforestation by attracting new migrants to the forest margins. But the relative profitability of forest conversion by smallholders it not determined solely by production technology; it also is tied to institutions and the legal framework that establishes, monitors and enforces boundaries of public land as well as private property rights; to policies regarding public investment in infrastructure and social services; and to macroeconomic policy instruments (exchange rates, monetary and fiscal policies). The institutional and policy environment that is necessary and sufficient for 'best bet' alternatives to reduce poverty *and* deforestation is not well understood yet--and is a top priority of ongoing ASB research. However, it is a sure bet that deforestation will accelerate if profitable innovations for rainfed land uses are introduced where there is open access to forests and within an economy-wide context of rapid population growth and stagnant opportunities elsewhere in agriculture, industry and services.

The key hypothesis underlying the ASB research project in Indonesia can be summarized as: *Intensifying land use as an alternative to slash-and-burn can reduce deforestation and reduce poverty.* Under which conditions is intensification a reasonable approach; under which ones is it not? At least three necessary conditions for validity of the intensification hypothesis were identified in ASB Phase I (van Noordwijk *et al.,* 1995) and some of their interrelationships are depicted schematically in Figure VI.1.

1. At the *plot level*, intensification technologies must be environmentally and agronomically sound, socially acceptable, and financially profitable for smallholders.
2. At the *community level*, there must be effective monitoring and enforcement of property rights.
3. At the provincial and national level, attention must be given to reducing the broader forces that drive deforestation.

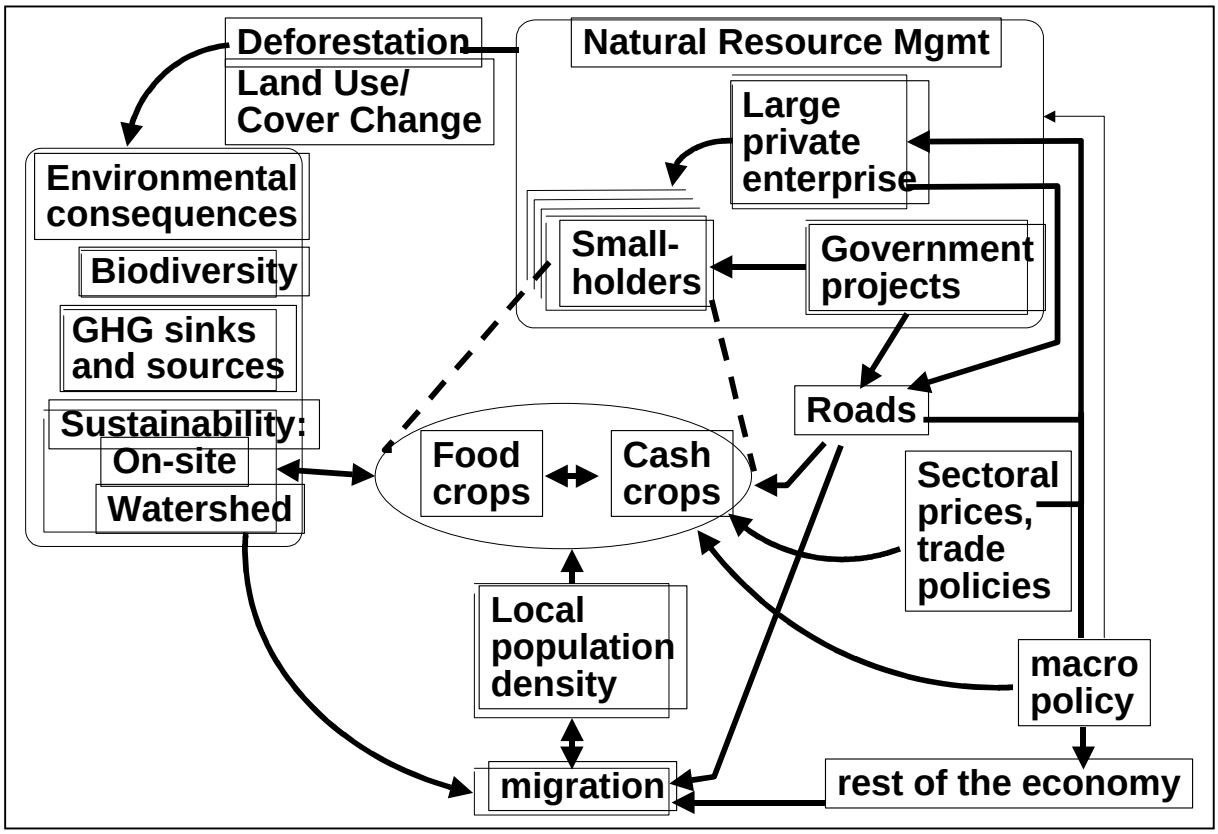

Figure VI.1 *Forces Driving Deforestation*

The first five parts of this report have focused on empirical measurement of relationships at the plot level. But property rights and tenure institutions, public investment in roads, trade policies, and macroeconomic shocks all affect households' livelihood options and, thereby, reduce (or intensify) forces that push migrants to forest margins; this policy and institutional 'environment' also has a powerful effect on the natural resource management decisions made by people at the forest margins. Each of these forms a component of ongoing research and is discussed below.

The overall programme—which is chiefly funded by the Asian Development Bank and the Ford Foundation--is designed to determine whether intensification of agroforestry production in specific upland settings can help Indonesia and other Southeast Asian countries and donor agencies balance environmental objectives with economic development and poverty reduction. These issues for policy and institutional research are nested as in Figure VI.2: each topic corresponds to a necessary condition for the intensification hypothesis; none is sufficient alone.

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SE Asia Regional Policy Research Project

Figure VI.2 Research Framework: *Decision Tree for Smallholder Agroforestry Systems for Upland Resource Management*

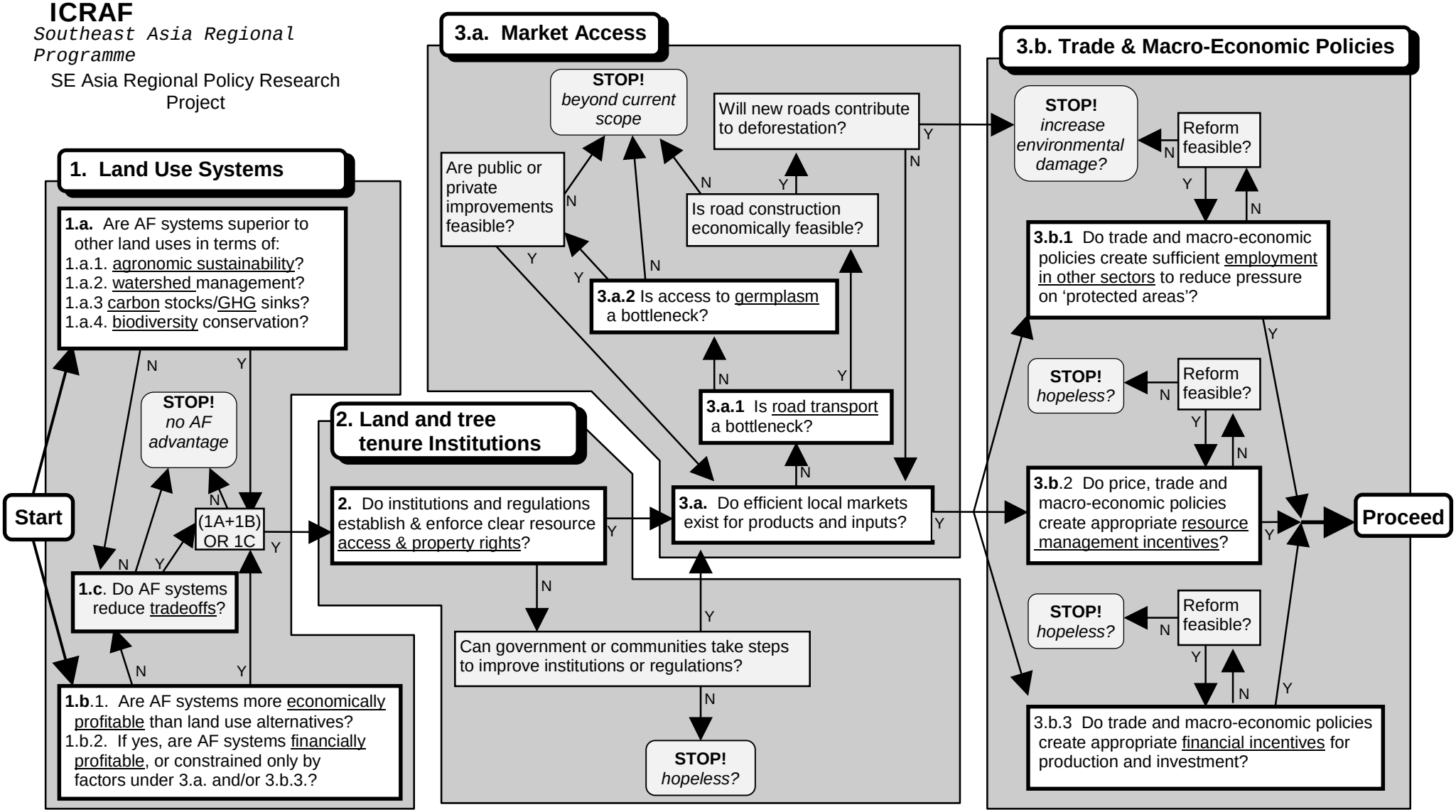


Figure VI.3 ICRAF Southeast Asia Regional Policy Research Agenda

Component	Scale	Main Policy Questions	Clients	Policy Instruments	Research Methods	*Collaborators*	Sites
Analysis of Land Use Systems	Plot	Are productivity increases feasible and profitable? If so, are they agronomically sustainable? And how are changes in technology and land use likely to affect the supply of global public goods?	Smallholders; NARS; ministries of agriculture, forestry, environment and finance; donor agencies.	Public investments in research and extension. Trade and price policies.	Application of the policy analysis matrix to analysis of private and social profitability, policy distortions, & market imperfections. Rapid assessment tools for agronomic sustainability & biodiversity. Measurement of C stocks & GHG emissions.	ASB Consortia in Indonesia and Thailand; including CASER, FORDA, LATIN, Lampung University and EU Project in Indonesia; Chiang Mai University and the Royal Forest Department in Thailand; TSBF, CIFOR.	Jambi and Lampung Provinces on the island of Sumatra in Indonesia. Northern Thailand, focusing on the Mae Chaem watershed with supplemental sites in Mae Taeng and elsewhere as needs are identified in consultation with research partners.
Analysis of Land Use Systems	Watershed / Landscape	How do changes in patterns of land use affect the supply of watershed functions? Specifically, what are the effects of land cover change on: (1) sedimentation of reservoirs, (2) flooding, and (3) seasonal water shortages?	Local communities, local government, NGOs, ministries of agriculture, forestry, environment, and public works; donor agencies.	Land use planning through local participation. Watershed classification. Public investment in infrastructure & other sectoral programmes. Resettlement policies.	Tools to be developed for rapid assessment of watershed functions. Spatial models of watershed functions.	ASB Consortia in Indonesia, Thailand, & the Philippines; incl. FORDA in Indonesia, Chiang Mai, Kasetsart, and Mae Jo Universities, Royal Forest Dept, Dept of Land Development, Royal Project Foundation, & ANU in Thailand, & UPLB in the Philippines.	Upper Tulang Bawang watershed in Lampung Province, Sumatra. Mae Chaem watershed in Northern Thailand. Manupali watershed on Mindanao in the Philippines.
Land & Tree Tenure: Indigenous Institutions	Household / Community	How do indigenous institutions adapt to population pressure? Do indigenous institutions establish and enforce clear resource access and property rights? How do these institutions affect resource management decisions?	Local communities, local government, NARS; NGOs; ministries of internal affairs, agriculture, and forestry; donor agencies.	Institutional endowments (customary, local government, NGO).	Econometric models.	IFPRI and Jambi University.	Various communities in the buffer zone of Kerinci Seblat National Park in Sumatra.
Land & Tree Tenure: Options for Institutional Reform	Community	Do existing institutions and regulations establish and enforce clear resource access and property rights? What can communities and government do to improve institutions and regulations in order to better meet social, economic, and environmental objectives?	Same as above.	Institutional reform. Land allocation policy. Sectoral programmes.	Process-oriented research on institutional reform.	LATIN, WATALA, ORSTOM, Univ. of Indonesia, Dept of Forestry and CIFOR in Indonesia. Chiang Mai University, Care-Thailand and Royal Forest Dept. in Thailand. Philippine collaborators to be identified.	Krui, Lampung Province, in the buffer zone of Bukit Barisan Selatan Nat'l Park and other communities to be selected in Indonesia. Buffer zone of Mt. Kitanglad Nat'l Park, Manupali watershed in Mindanao. Mae Chaem watershed in N. Thailand, including buffer zone of Doi Inthanon Nat'l Park.
National Policies: Market Access & Infrastructure	Provincial	How do decisions about location of road construction and other large government projects affect land use change? (Bottlenecks in access to improved germplasm may be studied later.)	Ministries of public works, resettlement, planning, forestry & agriculture; donor agencies.	Infrastructure investment. Land allocation & resettlement policies.	GIS-based spatial econometric models.	World Bank Policy Research Dept; UNESCO; BIOTROP in Indonesia; Chiang Mai University & Royal Forest Dept. in Thailand.	Sumatra with possibility of extension to Kalimantan in Indonesia. Mae Chaem watershed in N. Thailand.
National Policies: Macroeconomic & Trade Policies	National	How do macroeconomic & trade policies affect land use change? Do macroeconomic & trade polices create sufficient employment in other sectors to reduce pressure on land & forest resources?	Ministries of planning, finance, forestry, and agriculture; donor agencies.	Macroeconomic & trade policies.	CGE model with distinct regional components for labor flow between Java & Sumatra and detailed land use activities for lowland Sumatra.	IFPRI (in leading role) and CASER in Indonesia. School of Environment, University of Brighton	Java-Sumatra labor market interactions and their links with land use change in lowland Sumatra.

Synthesis of these results is intended to yield policy lessons relevant for the region. A **participatory, client-driven approach** is intended to enhance prospects for impact on institutional development and policy reform. ASB research priorities are driven by the needs of two broad groups of clients: smallholders living at the forest margins and policymakers who influence the range of choices available to these smallholders. Just as participatory methods are used in ASB research to understand smallholders' objectives and constraints, consultation with policymakers also is a hallmark of this client-driven approach to policy research. The focus of consultation is to obtain crucial insights from policymakers about their perceptions of problems, opportunities, and constraints, including institutional mechanisms for policy implementation, in order to guide the iterative process of research to identify and develop feasible policy options.

VI.2 Property rights and community participation in natural resource management

Land and tree tenure institutions -- both formal and informal -- affect resource access and property rights, and are a major determinant of incentives (and disincentives) for sustainable resource management. But do existing formal and informal institutions and the regulatory framework create incentives that are compatible with sustainable resource management? In particular, do tenure institutions and regulations establish and enforce clear resource access and property rights? If not, what (if anything) can governments do to better support improved functioning of these institutions?

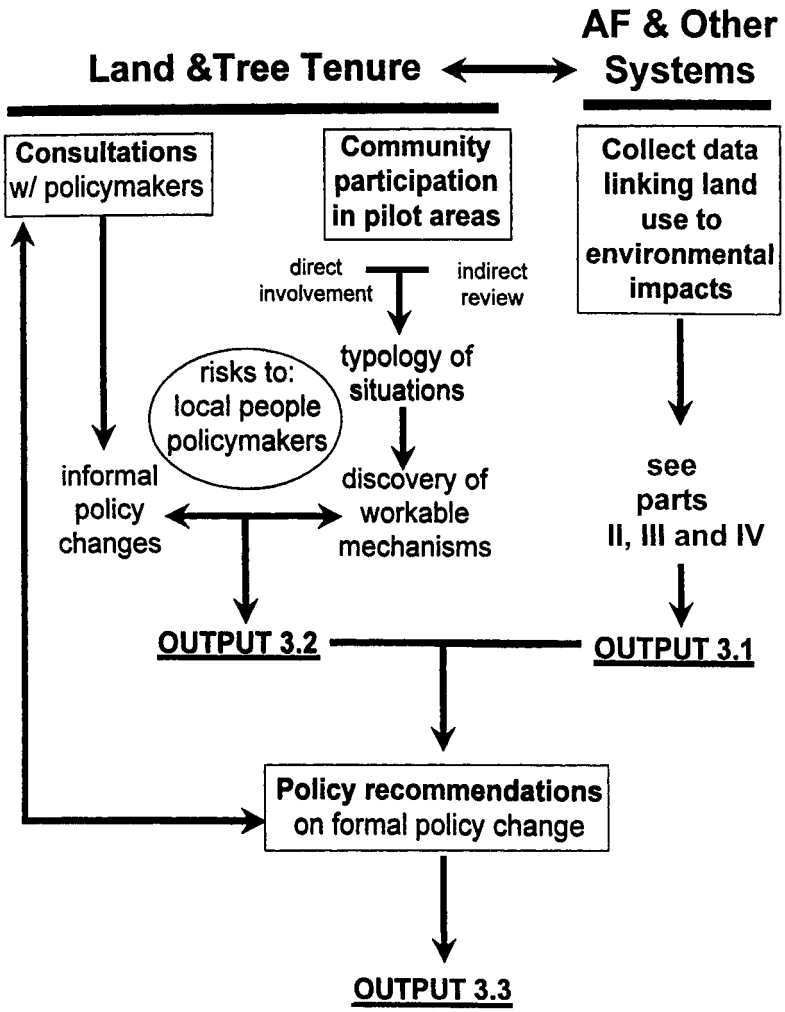
Existing resource access controls typically are inadequate to address the realities of poverty and land pressure in Indonesia and more generally in Southeast Asia. The result often has been increasing conflict among communities and between rural populations and the institutions of the state charged with managing forests. However, exceptional windows of opportunity currently exist in the region for institutional innovations aimed at authentic people's participation in forest resource management. (A new decree for community-based resource management in Indonesia is discussed in Part VII.)

While clearer property rights may be necessary to establish better incentives for natural resource management, they may not be sufficient to secure sufficient environmental benefits. For example, community management of buffer zones of protected areas may be a more effective means of monitoring and enforcing restrictions on forest encroachment by spontaneous migrants ('forest squatters') and illicit logging, but little is known about tradeoffs and complementarities among multiple goals in the implementation of such programmes. Another working hypothesis is that devolution of management of production forests (including logging) and/or watershed land use to local communities could improve natural resource management compared to the *status quo ante*. But devolution of control by itself may not create sufficient incentives for local communities to supply some forest services, including abatement of externalities felt at the regional level (flooding, siltation, smoke that impedes aviation) and global public goods (carbon sequestration and biodiversity

conservation). Workable institutional mechanisms that can clarify, monitor, and enforce responsibilities as well as rights are needed to address such complex natural resource policy issues.

Figure VI.4 was developed collaboratively during a regional planning workshop in 1996 to depict the interactions between the measurements of environmental, agronomic, and socioeconomic indicators described in Parts II-IV and which contribute to Output 3.1 of this project combined with pilot projects at the community level (described in Part VII) and ongoing consultations with policymakers. As stressed above, the measurements are necessary to quantify tradeoffs between various objectives. The process-oriented work is necessary to discover institutional options that have good prospects to meet the objectives of policymakers and of local people—which, in turn, contributes to Output 3.2 of this project. Both parallel streams of activity – empirical measurements and process-oriented research – are necessary and complementary efforts in providing a sound basis for recommendations for policy change. These recommendations comprise the 'deliverables' of Output 3.3, discussed in Part VII.

Figure VI.4 *Linking land use analysis to community participation in resource management*



VI.3 National policies and forces driving land use change

The return of severe financial instability in Indonesia--after three decades of steady growth--combined with new global and regional trade agreements may lead to significant dislocations of people and economic activity. Priorities for research on national policies affecting deforestation may be grouped in two sets of policy instruments that influence incentives for forest conversion: policies that affect market access and links between trade and macroeconomic policies and migration pressure.

Market access. Market access affects opportunities for land use by smallholders and large-scale operators and for local entrepreneurs, including those engaging in activities linked economically to forestry and agriculture (nurseries and seed producers, processors, traders and transport companies). Do efficient local markets exist for products and inputs? Investigations focus on two elements of market access – the road system and germplasm supply – but also will endeavor to identify other important market imperfections that may warrant further investigation.

The road system has powerful effects on people's access to resources and marketing links that condition land use choices in the uplands. Is transport infrastructure (especially the road network) sufficient for marketing agroforestry products? If transport is a bottleneck, how will road construction change land use? Obviously, it matters where roads are built; but ICRAF researchers work with colleagues from the World Bank, BIOTROP, and other collaborators to learn more about how interactions of road location and other factors (markets, property rights, sectoral policies, biophysical characteristics) affect land use choice in an effort to understand what determines whether a road project will be a boon for regional development or an environmental catastrophe.

Research on the dynamics of land use change in Jambi Province seeks to answer the policy question: where is smallholder 'encroachment' on logged-over forest most likely to be a problem? This spatial econometric analysis of land use change focuses on the peneplain and piedmont agroecological zones. A geographic information system (GIS) containing maps of rivers, main roads, land use units (topographic and edaphic features), and land cover for the early 1980s and the early 1990s was sampled with a one km grid, which generated 9477 observations. A multivariate econometric model with a binary dependent variable (a probit) was used to control for site-specific biophysical features (fixed effects) and to estimate the effect of distance to rivers and main (asphalted) roads on the probability that logged forest would be converted to rubber agroforests and other land uses by smallholders. The data indicate that there was substantial smallholder 'encroachment' on logged natural forests in Jambi between the early 1980s and the early 1990s. The prototype model correctly predicts about 85% of conversion of logged forests by smallholders

and about 78% of the cases where logged forest was not yet converted.[1] Site-specific biophysical features are highly significant, indicating that smallholders are selective in their choices of sites for conversion. Smallholder conversion of logged forest is significantly more likely within 10 km of main roads, which is consistent with a process driven by market opportunities for profitable treecrops. However, the results of this prototype model must be interpreted with great care. The period under study witnessed three big sources of change in Jambi: the all-weather Trans Sumatra Highway was completed, transmigration settlement projects expanded greatly, and large areas of the province were logged. Factors that affected which areas had been logged by the early 1980s (and which had not) may also affect the validity of our interpretation of these estimates. More work is needed to attempt to control for this possible selection bias. If these preliminary results hold up to further statistical refinements, this analysis can help set priorities for action within a two-pronged strategy combining community participation in management of some forest lands with improved monitoring and enforcement of access restrictions in other areas.

Trade and macroeconomic policies. Trade and macroeconomic policies affect households' livelihood options and, thereby, reduce (or intensify) forces that push migrants to forest margins; these policies also affect resource management decisions once they get there. Similarly, for subsistence-oriented communities who have long resided in remote forest areas, policies can affect opportunities for them to become more integrated into national economies, which could alter local land use patterns (and their sustainability) or shift labor away from agriculture or forestry into other sectors of the economy. Yet despite the dramatic change that trade and macroeconomic policies have already brought to Southeast Asia, the current shocks sweeping the region, and further important changes that will be forthcoming under global and regional trade agreements, the effects of these powerful policy instruments on rural land use patterns and incentives for forest conversion seldom have been analyzed. Are current trade and macroeconomic policies compatible with sustainable natural resource management by households? If not, what are the policy reform options? Are expanding employment opportunities in other sectors likely to take pressure off protected forest areas? If not, is forest conservation hopeless?

Research on these questions in Indonesia (and a twin study conducted for ASB in Brazil) is led by colleagues at IFPRI (the International Food Policy Research Institute) in collaboration with CASER (the Centre for Agro-Socio-Economic Research) and ICRAF Southeast Asia and is funded primarily by DANIDA. This study, entitled 'Macroeconomic Policy, Labor Migration, and Land Use in Sumatra,' is intended to answer a timely policy question: what are the impacts of structural adjustment programs (e.g., exchange rate devaluation, trade policy liberalization) on land use change

[1] The preliminary results presented in this paragraph are subject to revision and are not for citation or quotation. The findings, interpretations, and conclusions expressed in this paragraph are entirely those of the researchers. They do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent.

and deforestation? This research activity incorporates links between macroeconomic policies and the level of wages, which in turn affect migration and, ultimately, land use change. These issues will be analyzed using a regional Computable General Equilibrium (CGE) model. This approach is particularly appropriate when analyzing interactions between agriculture and industry, links between macro and microeconomics, and the impacts of changes in policy and world markets on production, employment, and income distribution. The prototype model comprises over 20 sectors, with particularly rich detail for agriculture. The database for the model is a regional social accounting matrix (SAM), which provides a consistent framework for analysis. The regional product accounts in the SAM capture the flows of goods and services and the regional income accounts depict income distribution among seven different types of households. Data on production technology are derived mainly from prior studies supplemented by the ongoing ASB research on major production systems in Sumatra reported in Part IV.

VI.4 Ongoing policy analyses and the monetary crisis

Beginning in August 1997 and continuing until now, Indonesia has suffered the greatest real exchange rate depreciation of any country in the past 50 years (IMF staff, pers comm). The ongoing monetary crisis in Indonesia creates both a need for the types of research described above as well as an opportunity to analyze how macroeconomic shocks affect land use change, environmental services, poverty, and household food security.

The policy analysis matrix (PAM) technique described in Part IV provides a flexible tool for examining the effects of Indonesia's monetary crisis on production incentives. Because these are simple, spreadsheet-based models, it is possible to revise basic macroeconomic parameters to reflect current changes in exchange rates and inflation. The results presented in Table VI.1 reflect the change from an exchange rate of Rp 4000 per US dollar in July 1997 to a real exchange rate of approximately Rp 7,700 in June 1998. This 'real' exchange rate is calculated by deflating the nominal exchange rate of Rp 11,550 per US dollar that prevailed early in June 1998 by the 50% inflation since July 1997. These partial equilibrium models provide only first-order approximations of shifting incentives resulting from Indonesia's financial collapse. However the data used in these calculations also will be employed in the CGE models mentioned above, which are able to capture effects on real wages and various other macroeconomic feedbacks.

Prior to the monetary crisis that began in Indonesia in August 1997, unsustainable shifting cultivation was not financially profitable in much of Sumatra. This appears to have changed since the collapse of the Indonesian currency over the past 12 months, which may reverse the long-term decline in shifting cultivation. Also because of the currency collapse, profitability of many tree-based systems has increased substantially, which boosts incentives for forest conversion by smallholders and large-scale operators alike (see Table VI.I).

Table VI.1 Sensitivity of PAM studies to macroeconomic parameters

Land Use	Rupiah 000's / ha		US $ / ha	
	July -- 1997	***June -- 1998***	***July -- 1997***	***June -- 1998***
Community - based forest management	9.4 - 18	38 - 75	3.9 - 7.7	5.0 - 9.7
Commercial Logging	(32) - 2,102	317 - 7,422	(13) - 876	41 - 964
Rubber agroforest (seedlings)	73	6,743	30	741
Rubber agroforest (clones)	*234 - 3,622*	*12,544 - 24,340*	*98 - 1,509*	*1,629 - 3,161*
Rubber monoculture	*(993)*	*5,114*	*(414)*	*664*
Oil palm monoculture	1,479	2,104	617	273
Upland rice / bush fallow rotation	(180) - 53	1,200	(75) - (22)	150
Monoculture cassava / *imperata cylindrica*	(314) - 224	3,536 - 4,038	(131) - 93	405 - 501

VI.5 Smoke as a symptom of underlying policy and institutional problems[2]

In 1994 large amounts of smoke, caused by fires in Sumatra and Kalimantan and aggravated by El Niño, resulted in poor visibility and air pollution for the neighbouring countries of Singapore and Malaysia and caused severe health problems for people in the entire region. In 1997 history repeated itself, and this time the consequences were even more serious and more widespread than they were 3 years ago. One effect of El Niño is an air temperature inversion over Southeast Asia, which traps smoke that otherwise would escape into the upper atmosphere.

Who is responsible for the fires in Sumatra, Kalimantan and elsewhere in Indonesia?

We must be cautious in attributing blame for the haze that shrouded the region. It has been customary to put all the blame on smallholders. But now, thanks to satellite images posted on the Internet, it is clear that big companies have important roles in the problem too. At least 3 types of fires contributed to the smoke that, together with the drought and atmospheric conditions brought on by El Niño, created the regional problem:

- ***fires used as a tool to clear land;***
- ***fires that accidentally got out of control; and***
- ***fires started deliberately as a weapon in social conflict.***

No one knows how many of the fires were started to clear land or to serve as a weapon and how many were accidental. Nor can anyone now say with certainty how much smoke is the result of smallholders' actions versus the actions of large companies. However, numerous eyewitness reports are consistent with official assessments based on remote sensing and site visits: that land clearing by large companies apparently played a major role in the problem.

Fire as a tool. Slash-and-burn is a technique for land clearing and conversion to other purposes. It also describes an extensive system of agriculture that leaves land fallow after a few years of crop growing and opens up new land for planting. Slash-and-burn is the preferred method of land clearing in Indonesia—for smallholders and large companies alike—because it is cheap and easy. In addition, fire eliminates field debris, decreases regrowth of weeds, reduces pest and disease problems, adds fertilizer in the form of ash and loosens the soil to make planting easier. In some ways it is preferable to other land-clearing methods. For example, bulldozers cause soil compaction, erosion and sedimentation.

Slash-and-burn as a land-use system worked well for smallholders for centuries because communities regulated the use of fires. However, when used as a technique to convert entire forests to rubber or palm oil plantations, the amounts of smoke those fires produce can be excessive. That is the

[2] This section on smoke draws heavily on Tomich *et al.* 1998 in *Agroforestry Today*. An earlier version of this material appeared as an ASB Update produced by the ASB-Indonesia Consortium and ICRAF's Southeast Asian Regional Research Programme.

problem this year, as it was in 1994—too much smoke in the wrong place at the wrong time. The objective then, is to reduce smoke emissions in critical years and during times of the year when smoke disperses slowly because of atmospheric conditions. Development policies for conversion of 'forestlands' are linked to the smoke problems Indonesia faced this year. 'Forestlands' are designated as state-owned lands, and they represent about 3/4 of the Indonesian land area. The many licenses granted each year to private companies for planting fast-growing timber species on forestland or oil palm on private land (that is, 'converted' state forestland) acts as a multiplying factor for fires. Because planters use fire to clear their fields and prepare them for planting, the 1997 fires should not have been totally unexpected. In this respect, smoke is an inevitable—if unintended—product of planned conversion.

Fire that accidentally spreads. Many local communities in Indonesia have created their own effective systems of fines and other penalties that are imposed on people who mismanage fire and cause damage to their neighbors' property. Until recently, no mechanisms have existed to punish incompetence or negligence in the use of fire by large companies. A monitoring and enforcement system also could be developed to detect and punish blatant misuse of fire by large companies.

Fire as a weapon . Millions of people live in the forestland areas but because they have no security of tenure, they can be evicted at any time to make way for development projects. Large companies have been known to burn land to drive out smallholders. Smallholders have been known to burn trees established by large companies to retaliate for perceived injustices. At the heart of this problem are conflicts over land, resulting from unclear and insecure property rights and land allocation policies that take too little account of established—albeit informal—local claims. Aside from contributing to social conflict, 'land grabs' by large companies that displace local people also undermine incentives at the community level to prevent, report and fight fires. If land allocation policies concentrate holdings while destroying incentives for on-the-spot fire prevention and management by the local people, there is a great risk that the present situation will be repeated.

It is important to note that part of the land granted to companies is not 'empty' forestland but land that has been occupied by farmers—often for centuries. These farmers have developed their own systems of land use, which they have to give up when the company takes over. Some companies try to accommodate farmers' needs but others don't, which leads to conflict. In these conflicts, fire is a powerful weapon for both planters and farmers.

These changes in land use disturb pre-existing social systems. They erode traditional techniques and social rules for fire control and increase social inequities and the perception of these inequities in rural areas. When lands are converted into estates, some smallholders may find jobs on the estates; some may be allowed to retain control of a piece of the land through the 'nucleus estate' scheme; some may move to other forestlands; and others will be forced to move to crowded urban

centres, becoming part of the already large group of urban poor. Seen from these perspectives, it is reasonable to conclude that the risks of fires can only increase in the coming years unless social and policy issues are addressed along with the technical causes of fire and smoke. This needs to be carried out at 2 levels: by understanding how present policies affect smallholders and by recognizing the wider consequences of all policies related to land allocation and land conversion, from both an ecological and a social perspective.

Options for managing fires and smoke. Banning fires as a land clearing tool has been the focus of efforts to respond to the crisis but it is not the only option for managing smoke emissions. Potential alternatives include measures to:

- promote land clearing techniques that do not produce smoke
- reduce land clearing or burning during El Niño years or at other critical times
- decrease the amount of timber that is burned

Option 1: Ban use of fire for land clearing. Banning fires has not been effective. Bans on burning didn't work in 1994, the last time smoke was a regional problem, they didn't work this year, and they won't work as long as fire is the cheapest way to clear land. Until a workable mix of regulations, incentives, and sanctions is in place for the big companies involved, there is a risk that the brunt of enforcement may fall on a few unlucky smallholders. This would simply add to the burdens the drought already imposes on the rural poor, without much prospect of an overall effect on the smoke problem now or in the future. (The exception may be to ban fires on peat swamps, which can smolder underground for months and produce much more smoke per unit area than do fires that occur on upland soils.)

Option 2: *Develop alternatives to unsustainable forms of slash-and-burn agriculture*. In contrast to bans on burning, Indonesia's partnership with a number of international organizations in the global ASB Programme to develop viable alternatives that diminish (if not eliminate) smallholders' need for burning is an approach that can reduce smoke and poverty, but has received scant media attention. Agroforests are a good examples of viable alternatives that are good for people's livelihoods, good for the economy and good for the environment.

Option 3: Clear land without burning. There are a number of land clearing techniques that do not produce smoke. These include biological methods to accelerate decomposition and various mechanical techniques that chip or shred biomass, either for mulching on-site or for transport off-site for disposal or sale. All of these 'no-burn' techniques are less effective and more expensive than burning. Research may be able to reduce the economic and technical costs of some environmentally benign techniques such as mulching. If subsidies for adoption of these techniques are administratively feasible, such payments may be an efficient means to reduce smoke emissions. To determine whether subsidies for adoption of no-burn techniques are appropriate, the social and economic costs of smoke must be compared with the costs of alternatives.

Option 4: Burn when it does less harm. It is not feasible to regulate burning by the many smallholders

who clear plots of a hectare or so. But government permits regulate land clearing by large companies. So, one option is to allow less clearing in El Niño years, which can be predicted. Another option is to require burning permits for large companies and to enforce sanctions on those that burn without permits or burn more than specified in their permits. Selective restrictions have been used elsewhere to prohibit burning when smoke would linger because of atmospheric conditions. Implementation of these options would require an effective monitoring system using remote sensing combined with on-site verification, stiff penalties, and certain enforcement. Offering permits through an auction could improve the efficiency of distribution among companies when rationing is needed, but may not be socially acceptable.

Option 5: Reduce the amount of timber that is burned. Indonesian forestry policies are designed to depress domestic prices of timber relative to world prices. Policies that depress prices of wood products increase the 'waste' that must be disposed of by burning or other means. If these policies were eased or removed, more of the wood felled in land clearing would be sold for timber, thereby reducing the amount that is burned. And if wood were sold instead of burned, there would be less smoke. The attractiveness of technological alternatives to clear land without burning discussed in Option 3—or the level of subsidies required for adoption of these techniques—also is influenced by national policies. In addition, since conversion forests are being planted mostly to oil palm, it is important to study alternative uses for the vast amounts of oil palm wood that will be available in the future.

Option 6: Recognize long-standing land claims. It is important to have balanced consideration for the community, the economy and the environment. Involving members of the community in decisions that affect their livelihoods and their tenure security would help to minimize conflicts over land allocation, thereby reducing use of fire as a weapon.

Deeper investigation is needed to reveal more of the facts behind these fires. But even with the limited information at hand, it is possible to identify certain steps that can be taken to help ensure that a catastrophe of this scale will not be repeated.

- Bans on burning may have symbolic value but are not practical because of the higher cost of alternative land clearing techniques. The exception would be to ban burning on peat soils. Reducing costs of alternative techniques deserves further study. However, this is a longer-term strategy, since widespread adoption of environmentally benign no-burn techniques will be slow until costs fall.

- Regulating burning by large operators and introducing penalties for the effects of accidental fires also deserves further study. BAPEDAL—the Indonesian agency charged with environmental protection—has already made impressive efforts in this direction. The agency has laid the foundation to develop ways to restrict burning to periods when smoke does less harm and to impose penalties on large companies that allow fires to get out of control. Investments in equipment and human resources are needed to sustain and strengthen BAPEDAL's new capacity to detect fires, verify their causes, analyze policies and provide timely, accurate information.

- Recognizing long-standing land claims would help minimize conflicts over land allocation.

- Reducing or eliminating restrictions that depress domestic timber prices would decrease the amount of timber that is burned after land clearing. Among these options, this one would be the easiest to implement and would have immediate effects.

In Part VII we report on important action on recognition of longstanding land claims and we present further analysis of timber export restrictions within the context of the agreements on economic and financial policy reform between Indonesia and the IMF.

VII. Output 3.3. Action at the local and national level

This part of the report concerns **Project Output 3.3**, *development and implementation of country action plans by (a) preparing policy briefs for relevant stakeholders for integrating biodiversity conservation and climate change mitigation in agricultural development in the forest margins and for implementing this integration through appropriate economic incentives and institutional reforms, and (b) consulting with national policy makers, land use planners, land users and natural resource managers to initiate the framing of country action plans or the relevant amending of existing plans* .

Policy and institutional barriers to adoption of alternative land uses have been analyzed and workable options to address tenure insecurity and certain trade policy distortions were developed in consultation with policymakers and other stakeholders. Ongoing collaboration, contact, and presence by national and international members of the research team are essential for real impact on policy and technology options. Under any circumstances, but especially because of the social, political, environmental, and financial crises that Indonesia now must face simultaneously, it is neither feasible—nor perhaps even desirable—to expect a grand strategy or comprehensive national plans of action regarding sustainable land use alternatives to slash-and-burn. However, as demonstrated by the examples discussed below, even the present dire circumstances still present opportunities for collaborative development of policy options and programmes that can further environmental goals along with poverty alleviation among people living at the forest margins. These opportunities need to be seen within the context of urgent policy priorities and the ongoing process of reform in Indonesia.

VII.1 A Policy Breakthrough for Indonesian Farmers in the Krui Damar Agroforests[3]

Djamaloedin Soeryohadikoesoemo, Indonesia's Minister of Forestry from April 1993 to March 1998, signed an historic decree in January 1998 that established an official precedent for community-based natural resource management in Indonesia. Based on the Minister's concept for a distinctive forest-use classification, '*Kawasan dengan Tujuan Istimewa*' (KdTI), the new ministerial decree recognises the legitimacy of community-managed agroforests on a significant area of State Forest Land.

For the first time in Indonesia, this decree recognises the environmental and social benefits of an indigenous land use system (damar agroforests), the role of indigenous institutions in sustainability of this natural resource management system, and the rights of smallholders to harvest and market timber and other products from trees they planted. While the new KdTI area still is part of the State Forest Zone, this classification is unprecedented in that:

- it sanctions a community-based natural resource management system as the official management regime within an area of the State Forest Zone

[3] This section draws heavily on Fay *et al.,* 1998.

- it allows the harvesting of timber from within the State Forest Zone by local people
- it allows the limited harvesting of timber from within a watershed
- it devolves the management responsibility of State Forest Lands to a traditional community governing structure (Masyarakat Hukum Adat)
- these rights are provided without a time limit.

This first KdTI area is in the heartland of the Krui damar agroforests in Lampung Province on the Indonesian island of Sumatra. These magnificent damar agroforests have been described elsewhere (*Agroforestry Today* 6(4):12-13; 8(1): 8-10; 9(4)18-20). Through a process developed by the Krui people a century ago, these agroforests begin with land clearing and planting of upland rice, which is followed by a succession of treecrops, including coffee, fruit trees, various timber species, and damar (*Shorea javanica*), which produces resin as well as timber. Through a blend of natural succession with management by farmers, these agroforests develop over a period of decades into a complex, multi-strata agroforestry system that approximates a number of forest functions, including biodiversity conservation and watershed protection. Satellite images indicate there are approximately 55,000 ha of these mature agroforests in Krui. The new KdTI area covers 29,000 ha of damar agroforests at various ages that fall within the State Forest Zone, with the balance being on private land.

At the invitation of the Indonesian Minister of Forestry, ICRAF and NGO partners LATIN and WATALA worked closely with Forestry Department counterparts to identify and develop workable options for implementation of the Minister's KdTI concept in Krui. This effort benefited greatly from previous research on the ecological, social, and economic functions of the Krui agroforests conducted by ORSTOM scientists, some of whom are seconded to ICRAF SE Asia. Subsequently, a research consortium grew that includes the 2 Indonesian NGOs, the University of Indonesia, CIFOR, and the ICRAF/ORSTOM team. Results of research by this 'Krui Team' assisted local farmers in their efforts to gain official recognition by documenting the myriad benefits of the damar agroforests as a resource management system. Since 1995, the research consortium has been working with Krui farmers to literally place their agroforestry systems on the map and to articulate the environmental and economic benefits of their system. Research and community organising produced numerous maps and detailed description and analysis of the Krui agroforests. In March 1997, the consortium conveyed requests from village leaders to the Minister of Forestry to initiate a dialogue with government concerning the status of their lands. In June, the consortium helped organise field visits from key government officials and a two-day workshop where research results were presented and the status of the land was discussed. The results of these activities were reported to the Minister of Forestry and, six months later, the pathbreaking decree was signed.

ICRAF and the other partners in the Krui research consortium now are organising a process of consultation with villagers and local government to discuss the rights and responsibilities the new

KdTI classification provides and to plan for implementation of the KdTI concept in Krui. In addition, Krui farmers have requested that ICRAF explore ways to increase diversity and productivity of their damar agroforests. This work will centre on understanding the existing genetic diversity of the most important tree species in the agroforests and identifying superior provenances. ICRAF and ORSTOM also conduct research on local timber extraction practices and plan new research on outcome-based measures for rapid assessment of natural resource management objectives.

It is hoped that this research on implementation in the Krui KdTI area and on the new tools for environmental impact assessment will provide insights for the replication of this approach widely within Indonesia. The Krui experience has gained the attention of researchers working on similar problems as far away as Cameroon. African scientists visited the Krui agroforests as part of the activities of the Alternatives to Slash-and-Burn Programme (ASB) and they now have expressed interest in the details of the new classification in the hope that lessons can be shared between Indonesia and Cameroon regarding implementation options.

At least 7,000 families in the KdTI area will benefit directly from the decree's official recognition of their rights. If this pilot effort is implemented successfully, it is hoped that the KdTI prototype can be applied in numerous other locations in Indonesia, with benefits for hundreds of thousands of households through poverty alleviation, improved resource management, and reduction of social conflict. Indeed, this can be viewed as an effort by Minister Djamaloedin to address human rights issues arising from conflict over forestlands as well as the pursuit of environmental objectives and poverty alleviation.

Until this decree was issued, the Krui agroforests were at risk because of the uncertainty of their tenure status. One serious implication of this legal status was that a forestry company held the government-awarded right to manage this area, including the possible harvesting of an estimated 3 million commercially valuable trees planted by local people. In addition, local farmers expressed growing concerns over the uncertainty of their rights to the damar agroforests they have planted and are currently managing. Many damar farmers adopted a 'wait and see' strategy and chose not to plant damar and fruit trees until they would know for sure that they will be able to harvest the benefits of their work. This uncertainty clearly endangered the very future of a system that is renowned worldwide as an example of successful and sustainable management of forest resources by a local community.

VII.2 Analysis of timber export taxes and marketing restrictions[4]

Although Indonesia now faces extremely severe economic challenges, this difficult situation also presents certain opportunities to lay foundations for a stronger, healthier, and more equitable forestry sector. Removing existing constraints and disincentives that hamper agroforestry tree production by smallholders would benefit Indonesia overall while accelerating compliance with forestry components of agreements between Indonesia and the IMF. Smallholders have an important role to play in Indonesia's transition from 'mining' its natural forests to sustainable production of forest products.

Elimination of disincentives to smallholder production by deregulating agroforestry tree species is an important—and administratively easy—first step toward realizing farmers' potential contributions to meeting growing commercial demand for forest products and to rehabilitating 'critical' watersheds in Indonesia. The rehabilitation of more than 50,000 hectares of forest through damar agroforest establishment by local communities in Krui mentioned above, the 'Sengonisasi' program in West Java, the over two million hectares of productive rubber agroforests in Kalimantan and Sumatra, and the growing importance of teak in farmers' fields in Daerah Istimewa Jogyakarta are evidence of the potential of farm forestry in Indonesia. Experience of other countries in the region, particularly the Philippines, also indicates that smallholder production of forest products could be economically efficient, environmentally sustainable, and socially equitable.

Deregulation of trade and marketing of agroforestry species is a *win-win* opportunity for the newly-renamed Department of Forestry and Plantations, providing tangible benefits for small-scale farmers, the forestry industry, the national economy, and the environment. Smallholders would benefit immediately through relief from the burden of counterproductive regulations. In the medium term, domestic timber processors would gain from the expansion of a sustainable supply of raw materials. Significant increases in exports of agroforestry timber—from wood that currently is wasted--would help Indonesia earn foreign exchange. This would also produce environmental benefits through the expansion of tree production on degraded lands.

This section is in four parts. First, we define precisely what we mean by 'agroforestry species'. Second, we discuss existing disincentives to smallholder production of these species. Third, we suggest some principles as a conceptual basis for comprehensive deregulation of these species. Finally, we review advantages of deregulation of these species for Indonesia and discuss how these recommendations fit with Indonesia's agreement with the IMF.

Agroforestry Species Produced by Smallholders. Some of the most complex forestry policy questions concern management of Indonesia's 'old growth' natural forests. But there are a significant number of agroforestry tree species grown by smallholders (and by large-scale estate plantations) that

[4] This section is drawn from a series of policy memoranda prepared by TP Tomich and H de Foresta.

are not natural forest species. Complete deregulation of these agroforestry species thus poses no threat to Indonesia's natural forests.

After consultation with colleagues in the Department of Forestry and Plantations, an initial list of 30 agroforestry tree species were identified that all are good candidates for immediate deregulation (see Table VII.1). Three types may be recognized that help to clarify the ecological and economic roles of each species for smallholders.

Table VII.1 30 agroforestry species for immediate deregulation

Indonesian name	**Latin name**
Type I. Exotic species	
Karet	*Hevea brasiliensis*
Jati	*Tectona grandis*
Mahoni	*Swietenia spp.*
Pinus	*Pinus spp.*
Afrika	*Maesopsis eminii*
Type II. Indigenous multipurpose species	
Damar matakucing	*Shorea javanica*
Mindi	*Melia azedarach*
Kelapa	*Cocos nucifera*
Mangga	*Mangifera indica*
Durian	*Durio zibethinus*
Duku	*Lansium domesticum*
Cempedak	*Artocarpus integer*
Manggis	*Garcinia mangostana*
Kapok	*Ceiba pentandra*
Asem Jawa	*Tamarindus indica*
Kemiri	*Aleurites moluccana*
Type III. Pioneer timber species	
Sungkai	*Peronema canescens*
Sonokeling	*Dalbergia latifolia*
Sonokembang	*Pterocarpus indicus*
Jeungjing, Sengon	*Paraserianthes falcataria* or *Albizzia falcata*
Johar	*Cassia siamea*
Jabon	*Anthocephalus chinensis*
Bayur	*Pterospermun javanicum*
Surian	*Toona sinensis*
Terap	*Artocarpus elasticus*
Mahang	*Macaranga spp.*
Pulai	*Alstonia spp.*
Puspa	*Schima wallichii*
Simpur	*Dillenia spp.*
Terentang	*Campnosperma auriculata*

- ***Type I. Exotic species***. None of these species are found in Indonesia's natural forests. Consider rubber wood, which is a substitute for ramin, one of the most valuable natural forest species. With the depletion of ramin, rubber wood has emerged as an important by-product of natural rubber production. Teak, mahogany, and all but one of Indonesia's pines (*Pinus merckusii*) also are exotics. Although presently grown mainly in large-scale plantations dating from the colonial era, smallholders (including transmigrants) are strongly interested in planting these species (often beside roads and along fence rows) despite their relatively long gestation periods because of the high value of their sawn timber.

- ***Type II. Indigenous multipurpose species.*** Coconut is the most widespread of these common species. Farmers mainly plant them for non-timber products, but timber is a valuable by-product at the end of the tree's productive life. These species are grown in large quantities by smallholders. Although these are indigenous species, most trees of these species now are planted and only a small proportion of these trees are found in Indonesia's natural forests.

- ***Type III. Indigenous 'pioneer' timber species.*** Although indigenous to Indonesia's natural forests, these fast-growing, light-loving species specialize in gap filling and, hence, are rare in old-growth natural forests. Their ecological niche also means they are well suited to domestication and planting in farmers' fields. Species such as bayur have been semi-domesticated and now are almost exclusively produced in farmers' fields.

Disincentives to Smallholder Agroforestry. There are at least two major barriers to smallholder production of timber and other 'forest' products in Indonesia. First is tenure insecurity for millions of smallholders because of conflicting claims on land that no longer is natural forest. As discussed above, a long-term process may be necessary to develop workable and enforceable agreements between Government and local communities regarding land use and production sharing rights *and* responsibilities on these lands. Second are disincentives to smallholder production created by trade and marketing restrictions that undermine incentives regardless of where production takes place, even on private land. This section focuses on this second major barrier because the benefits of deregulation of trade and marketing could be felt immediately by millions of smallholders throughout the country.

Current regulations covering trade and marketing of timber and on some other 'forest' products are designed for natural forest products –'gifts from God'—but are inappropriately applied to agroforestry products, which are produced from farmers' own labor, land, and capital. These policies, which penalize smallholders who grow trees on their farms, include:

- **Export taxes.** Indonesia's timber export taxes are intended to promote domestic wood processing industries. The previous timber tax system had the same effect as an export ban because the tax rates were 'prohibitive' (the export taxes exceeded world market prices, so it did not pay to export). Those prohibitive taxes drove down domestic prices for all timber species. Export taxes for logs and sawn timber now are 30%; these taxes are scheduled to be reduced to 20% by the end of 1998. For the agroforestry species described above, these export taxes depress incomes of smallholder producers. The resulting harm to smallholder income and livelihoods is an unintended side effect of these export taxes.

- **Natural resource rents and royalties** (*IHH*). According to formal forestry regulations, IHH only applies to products harvested from State Forest Land (*Kawasan Hutan*). It is common practice—for example regarding damar resin in Krui and rattan species planted by farmers in

Kalimantan--to assess IHH regardless of a product's origin simply because it often is impossible to determine the origin *of some products* with any certainty.

- **Administrative procedures for harvesting and transporting timber and other products** which have been classified as 'forest' products – such as damar resin, kayu manis and kemiri. In addition to being an administrative burden, the current complex felling and trading procedures for timber and other products grown on farms create various opportunities for illegal levies.

In all these examples, trade and marketing policies that are intended for products from natural forests are inappropriately being applied to species that are planted by smallholders. The result is increased marketing costs, which reduce or eliminate farmers' profits. Particularly because these products all require substantial time and investment to produce, inappropriate application of these regulations make production of agroforestry products, including timber, much less attractive than farmers' other alternatives. In addition, various local levies (*retribusi*) on timber and other agroforestry products have been administered in ways that place a heavy burden on small-scale producers and traders. These local levies are inefficient because the economic costs are high compared to the revenue generated.

A Conceptual Framework for Deregulation. The following principles provide a framework for integrated assessment of policy options for deregulation of agroforestry species.

1. 'Resource rent taxes' should be applied only to products that are 'gifts from God', such as timber from Indonesia's ***natural*** forests. For example, 'resource rent taxes' should not apply to damar resin and timber produced by farmers in Krui and timber from rubber trees planted by farmers and estate plantations.

2. All direct taxes (including export taxes, taxes on forest products and 'resource rent taxes') should be eliminated for tree species that are mainly grown on small farms and large plantations. These taxes are difficult and expensive to administer compared to the revenue they raise. They are a nuisance to producers and, more importantly, they represent a strong disincentive to smallholders who would like to plant trees with commercial value.

3. The Government's Memorandum on Economic and Financial Policies issued on 15 January seeks to reorient production, processing, and marketing of forestry and agroforestry products toward market mechanisms and away from regulation and central planning. Market mechanisms are most efficient for handling processing and marketing of forest products--minimize government intervention in these commercial activities.

4. Priority in the forestry sector should go to management of those lands that are still covered with natural forests. Market forces alone are not sufficient for management of these natural forests (including parks and nature reserves as well as production forests), whose area and quality have been degrading at an alarming rate.

Reasons to Deregulate Agroforestry Species

1. **Accelerate deregulation for species that pose no threat to Indonesia's natural forests**. Unlike trees in natural forests, which are 'gifts from God', these agroforestry species are planted and managed by smallholders just like agricultural commodities.

2. **Alleviate poverty**. Current harvesting and trade regulations deprive poor households of income because they depress prices smallholders could receive for timber and other 'forest products' from trees that they grow. Therefore, deregulating harvesting and trade on agroforestry species would help alleviate poverty.

3. **Secure a sustainable timber supply**. Removing current regulations on harvesting and trade of timber for agroforestry species would significantly improve incentives for development of Indonesia's smallholder farm forestry subsector. This would be an important step toward realizing the potential of smallholders to make a bigger contribution to meeting growing commercial demand for timber.

4. **Rehabilitate 'critical' lands.** Deregulation of agroforestry species would raise the economic benefits of growing trees on degraded lands and provide a new stimulus for farmers to rehabilitate lands that were marginal for agricultural production. Therefore, deregulating harvesting and trade in agroforestry species would help promote reforestation and thereby produce environmental benefits on a local, regional, national and global scale.

5. **Enhance efficiency in meeting goals of the Department of Forestry and Plantations.** Since current harvesting and trade regulations do not differentiate products from natural forests from those harvested from farmers' fields, these regulations unnecessarily increase the Department's administrative burden. Deregulating agroforestry species would allow the Department to focus its limited budget and human resources on its 'natural' priority: management of State Lands that still are covered by natural forests in order to achieve a better mix of production and conservation.

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Annex B. Equipment provided and recommendations for transfer

A Shimadzu Gas Chromatograph was obtained with project funds and equipped for measurements of nitrous oxide. The equipment was placed in the laboratory of BIOTROP / Global Change Impact Centre (IC-SEA) and its future use for measurements related to the ASB project is covered by a memorandum of understanding, signed by Dr. Pedro Sanchez on behalf of ICRAF and Dr. Arsyad on behalf of BIOTROP, and by Dr. Meine van Noordwijk and Dr. Daniel Murdiyarso as scientists involved.

Annex C. List of Scientific Personnel -- ASB PHASE II

1. A. M. Fagi, PhD	Director, Central Research Institute for Food Crops (CRIFC)
2. Djuber Pasaribu, Ir., MSc.	Agronomist, Project Leader, CRIFC
3. Sunendar K.	Head of Research Programme, CRIFC
4. Soetjipto Partoharjono, PhD	Researcher, CRIFC
5. Zulkifli Zaini, Ir.	Researcher, CRIFC
6. Robert Simanungkalit, PhD	Microbiologist, CRIFC
7. A. Abdurachman, PhD	Director and Soil Scientist, Center for Soil and Agroclimate Research (CSAR)
8. Achmad Rachman, Ir., MSc.	Soil Conservation Specialist, CSAR
9. Undang Kurnia, PhD	Researcher, CSAR
10. Soleh Sukmana, PhD	Soil Conservation Specialist, CSAR
11. Husein Sawit, PhD	Researcher, Center for Agro-Socioeconomic Research (CASER)
12. Prajogo Utomo Hadi SE, M.Ec.	Agroeconomist, CASER
13. Fauzia Sulaiman, PhD	Sociologist, CASER
14. Gelar Satya Budhi, Ir.	Researcher, CASER
15. Andin H. Taryoto, PhD	Agroeconomist, CASER
16. Harry Saleh, Ir., MSc.	Community and Regional Specialist, Ministry of Transmigration and Forest Squatters Resettlement
17. Agus DS, PhD.	Remote Sensing Specialist, Transmigration
18. Saraswati Soegiharto, Ir., MA.	Socio Economist, Transmigration
19. Baslian K. Yosa, Ir.	Soil Scientist, Transmigration
20. Kustomo Usman, Ir.	Landscape Planner, Transmigration
21. Widarjanto, Ir.	Soil Scientist, Transmigration
22. Teti Herawati, Ir.	Demographer, Transmigration
23. Wagiran, Ir.	Demographer, Transmigration
24. M. Arief Ilyas, Ir.	Water Resource Specialist, Water and Irrigation Research Center, Public Works Department
25. Kurniatun Hairiah, PhD	Root Ecologist, University of Brawijaya
26. S.M. Sitompul, PhD	Plant Physiologist, University of Brawijaya
27. Suryo Hardiwinoto, PhD	Silviculturist and Forest Ecologist, University of Gajah Mada (UGM)
28. Heru Iswantoro, Ir., MSc.	Sociologist/Rural Development Specialist, UGM
29. M.Sambas Sabarnurdin, MSc, PhD	Forest Silviculturist, Site Coordinator for Bungo Tebo, UGM
30. Muhajir Utomo, PhD, MSc.	Soil Management Specialist, University of Lampung (Unila)
31. Dr. Bustanul Arifin, PhD	Agricultural Economist, Unila
32. Agus Hudoyo, Ir.	Researcher, Unila
33. F.X. Susilo, PhD	Soil Fauna Scientist, Unila
34. I.G. Swibawa, MSc.	Soil Fauna Scientist, Unila
35. S. Murwani, MSc.	Soil Fauna Scientist , Unila
36. Naik Sinukaban, PhD	Soil Conservationist, Bogor Agricultural University (IPB)
37. Iswandi Anas, PhD	Soil Microbiologist, IPB
38. Yadi Setiadi, PhD	Mycorrhiza Specialist, IPB
39. Djunaedi, Ir.	Soil Microbiologist, Graduate Student, IPB
40. Daniel Murdiyarso, PhD	Head/Ecosystem Modeller, Impact Centre for Southeast Asia, Southeast Asian Regional Center for Tropical Biology (BIOTROP)
41. Upik Rosalina, PhD	Forest Ecologist & Remote Sensing Specialist, BIOTROP
42. Agus Eka Putra, PhD	Forest Ecologist, BIOTROP

43. Iwan Setiawan, Ir.	Forester, BIOTROP
44. Setiabudhi	Vegetation Analyst, BIOTROP
45. A. Ngaloken Gintings, PhD	Director, Forest Products and Socio-Economics Research Development Center (FPSERDC)
46. Wesman Endom, Ir., M.Sc.	Researcher, FPSERDC
47. Machfudh, PhD	Researcher, FPSERDC
48. Asih S. Irawanti, Dra., M.E.	Researcher, FPSERDC
49. Retno Maryani, Ir., M.S.	Researcher, FPSERDC
50. Gede Wibawa, PhD	Agronomist, Rubber Research Institute Sembawa
51. Hisar Sihombing, PhD	Soil Scientist, Rubber Research Institute Sembawa
52. Arif Aliadi, Ir.	Program Director, The Indonesian Tropical Institute (LATIN)
53. Wibowo A. Djatmiko, Ir.	Program Coordinator, LATIN
54. Kusworo	Researcher, WATALA
55. Iwan Tjitradjaja, PhD	Director, P3AE UI, University of Indonesia
56. Hadi Pasaribu, PhD	Directorate General, Replanting and Land Rehabilitation, Department of Forestry
57. Andrew N. Gillison, PhD	Principle Scientist, Center for International Forestry Research (CIFOR)
58. Nining Liswanti, Ir.	Research Assistant, CIFOR
59. Dennis P. Garrity	Regional Coordinator, International Centre for Research in Agroforestry (ICRAF)
60. Pratiknyo Purnomosidhi, Ir., MS.	Associate Research Officer, ICRAF
61. Suyanto, Ir., MS.	Agricultural Economist, ICRAF
62. Thomas P. Tomich, PhD	Natural Resource Economist, ICRAF
63. Yanti Kusumanto, M.Sc.	Research Officer and Project Manager, ICRAF
64. Fred Stolle, M.Sc.	Research Associate, GIS and Remote Sensing Analyst, ICRAF
65. Danan Prasetyo Hadi, Ir.	Assistant Research Officer, GIS, ICRAF
66. Chip Fay	Tenure Specialist, ICRAF
67. Suseno Budidarsono, Drs., M.Sc	Associate Research Officer, Agricultural Economics, ICRAF
68. Martua Thomas Sirait, M.Sc.	Associate Research Officer, Community Forestry Policy, ICRAF
69. Meine van Noordwijk, PhD	Soil Ecologist, ICRAF
70. Grégoire Vincent, PhD	Ecological Modeller, ICRAF
71. Betha Lusiana, Ir.	Associate Research Officer, ICRAF
72. Subekti Rahayu	Database Management, ICRAF
73. Quirine M. Keterings, M.Sc.	Researcher, PhD Student, ICRAF
74. Hubert de Foresta, PhD	Forest Ecologist, ORSTOM/ICRAF
75. Genevieve Michon, PhD	Agroecologist, ORSTOM/ICRAF
76. Eric Penot, MSc.	Rubber agronomist, CIRAD/ICRAF
77. Erwidodo, PhD	Economist, CASER

Annex D. List of Persons Trained -- ASB PHASE II

No.	PARTICIPANTS	INSTITUTIONS	EVENT			
			Policy Analysis Matrix	Belowground Biodiversity-Lampung	Belowground Biodiversity-Jambi	Century Model
1	Bustanul Arifin	University of Lampung	x			
2	Agus Hudoyo	University of Lampung	x			
3	Retno Maryani	Forest Products and Forestry Socio-Economics Research and Development Centre, Ministry of Forestry	x			
4	Setiasih Irawanti	Forest Products and Forestry Socio-Economics Research and Development Centre, Ministry of Forestry	x			
5	Machfudh	Forest Products and Forestry Socio-Economics Research and Development Centre, Ministry of Forestry	x			
6	Wesman Endom	Forest Products and Forestry Socio-Economics Research and Development Centre, Ministry of Forestry	x			
7	Prajogo U. Hadi	Center for Agro Socio-Economic Research, Agency for Agricultural Research and Development, Department of Agriculture (CASER)	x			
8	Gelar Setya Budhi	Center for Agro Socio-Economic Research, Agency for Agricultural Research and Development, Department of Agriculture (CASER)	x			
9	Arif Aliadi	The Indonesian Tropical Institute (LATIN)	x			
10	Wibowo A. Djatmiko	The Indonesian Tropical Institute (LATIN)	x			

11	Dr. Daniel Murdiyarso	Bogor Agricultural University		x	x	x
12	Dr. Meine van Noordwijk	ICRAF-South East Asia		x	x	x
13	Dr. Kurniatun Hairiah	Brawijaya University		x	x	x
14	Dr. Suryo Hardiwinoto	Gadjah Mada University (UGM)		x	X	
15	Dr. S.M. Sitompul	Brawijaya University				x
16	Pratiknyo Purnomo S.	ICRAF-South East Asia		x	x	
17	Dr. Robert Simanungkalit	Central Research Institute for Food Crops		x	X	
18	Dr. Iswandi Anas	Bogor Agricultural Univ.		x	x	
19	Dr. Yadi Setiadi	Bogor Agricultural Univ		x	x	
20	Dr. F.X. Susilo	Lampung University		x	x	
21	Sri Murwani	Lampung University		x		
22	Gde Swibawa	Lampung University		x		
23	Agus Cahyono	Gadjah Mada University (UGM)			x	
24	Agus Eka Putra	SEAMEO-BIOTROP			x	
25	Setiabudi	SEAMEO-BIOTROP			x	
26	Asmahan	Bogor Agricultural Univ (Student)			x	
27	Indrayati	Gadjah Mada University (UGM) (student)			x	
28	Nining Liswanti	CIFOR			x	
29	Dr. Andy Gillison	CIFOR			x	
30	Dr. Mike Swift	Tropical Soil Biology Fertility (TSBF)			x	
31	Haris Kriswantoro	Bogor Agricultural Univ (Student)			x	x
32	Hendrien Beukema	ICRAF			x	
33	Quirine Ketterings	ICRAF (student)			x	
34	Agus Priyono	Gadjah Mada University			x	
35	Sandy Williams	ICRAF (student)			x	
36	Didik Suprayogo	Brawijaya University				x
37	Edwin Rowe	ICRAF (student)				x
38	Betha Lusiana	ICRAF-South East Asia				x
39	Subekti Rahayu	ICRAF-South East Asia				x
40	Iwan Setiawan	SEAMEO-BIOTROP				x
41	Desi Ariyadi Suyamto	IC-SEA-BIOTROP				x

Annex E.

Policy Analysis Matrices for Six Major Land Use Systems of Sumatra's Peneplains

Studies of private and social profitability: Major land use systems in lowland Sumatra

Land use system: Small-scale forest extraction

Specific example: NTFPs & occasional small-scale

Scenario 1

Extraction area : 13,179 ha

NTFPs: petai, fish, durian and jengkol, (all extracted every year) and honey (extracted once in three years)

	Revenues (Rp)	Cost (Rp)			Profits (Rp)
		Tradable Inputs	Domestic factors		
			Labor	Capital	
Private prices	24,978	698	8,307	1,023	15,973
Social prices	32,309	912	10,847	2,053	18,497
Effect of divergences	(7,331)	(214)	(2,540)	(1,030)	(2,524)

Scenario 2

Extraction area : 35,061 ha

NTFPs: petai, fish, durian, jengkol, rattan and song birds (all extracted every year) and honey (extracted once in two years)

	Revenues (Rp)	Cost (Rp)			Profits (Rp)
		Tradable Inputs	Domestic factors		
			Labor	Capital	
Private prices	12,594	263	4,380	444	7,951
Social prices	16,193	343	5,571	837	9,442
Effect of divergences	(3,599)	(80)	(1,191)	(1,063)	(1,491)

Team members: Arif Aliadi and Wibowo A. Djatmiko

Study sites: Rantau Pandan District, Jambi Province

Production PAMS: 1 'whole forest' PAM for entire community forest area, with component PAMs as necessary for specific activities disaggregated for gathering of tradables (timber, rotan, birds nests) and for hunting and fishing and other discrete activities; gathering activities that generate joint nontradable outputs will be aggregated.

Discounting period for production PAMS: 25 years.
Note, however, that the team identified patterns and fluctuations in extractive activities over the past ten years or so and used these data to derive estimates of annual averages. These averages then were discounted over a 25-year period to enable comparability with other studies.

Resource degradation concerns? Need to be alert to possible depletion of resources, but the PAM is intended to represent a steady state (if that is the case)

Processing PAMS: not applicable

Small-scale forest extraction, *continued.*

Regional externalities (to be noted, but not measured) in production or processing?
No negative regional externalities expected.

Data challenges and other special features:
This team's data collection assignment was probably the most difficult because of the following factors:

1. Difficulty of identifying the major forest products gathered over the past ten years or so and understanding extraction patterns because of the variety of NTFPs, seasonal variation, and inter-year variation.
2. Delineation of forest boundaries and total area.
3. Difficulty in assessing the sustainability of extraction practices; in other words, are forest resources being depleted?
4. Distinguishing household activities from community activities.
5. Effect of tenure insecurity on resource management incentives.
6. Identifying and quantifying activities to maintain and secure use rights and resource access and to circumvent regulations
7. Many of these activities are illegal.

Policy issues / simulations:

1. Elimination of quantitative export restrictions, export taxes, and marketing restrictions that apply to most of the major products.
2. Level of effort to secure and maintain use rights as a proxy for impact of tenure uncertainty.
3. Technical options for enrichment planting and forest management.
4. Public policy regarding pricing of timber from natural forests.

Studies of private and social profitability: Major land use systems in lowland Sumatra

Land use system: Shifting cultivation

Specific example: upland rice / bush fallow rotation

Scenario 1
Short fallow upland rice

	Revenues (Rp)	Cost (Rp)			Profits (Rp)
		Tradable Inputs	Domestic factors		
			Labor	Capital	
Private prices	453,903	20,615	554,954	95,725	(217,391)
Social prices	589,258	25,862	655,034	88,395	(180,033)
Effect of divergences	(135,355)	(5,247)	(100,079)	(7,330)	(37,358)

Scenario 2
Long fallow upland rice

	Revenues (Rp)	Cost (Rp)			Profits (Rp)
		Tradable Inputs	Domestic factors		
			Labor	Capital	
Private prices	371,375	11,245	372,418	63,808	(76,096)
Social prices	482,120	14,107	362,034	52,959	53,021
Effect of divergences	(110,745)	(2,862)	(100,079)	(10,850)	(129,117)

Team members: Bustanul Arifin and Agus Hudoyo

Study sites: Rantau Pandan District, Jambi Province

Production PAMS:
2 or more PAMs for differing fallow periods to be identified after consulting with farmers to determinate critical periods to re-establish soil fertility (say, for example, fallow periods of 5 years and 10 years)

1 or more PAMs for wet rice in order to make a whole farm/whole forest PAM in collaboration with other teams.

Discounting period for production PAMS: 25 years, with multiple fallow rotations to examine effects of any resource degradation.

Resource degradation concerns? Yes, at least 1 PAM (the one for the shortest fallow period) is expected to show declining production of upland rice.

Processing PAMS: not applicable

Regional externalities (to be noted, but not measured) in production or processing? There is a possibility of sedimentation from soil erosion for shortest fallow period.

Shifting cultivation, *continued*

Data challenges and other special features:

1. Determining if fallow periods are changing.
2. Data on effects (if any) of shortening fallow period on upland rice profitability.
3. Build a whole farm/whole forest PAM for the Rantau Pandan site in collaboration with the small-scale forest extraction team and the smallholder rubber team.

Policy issues / **simulations:**

1. How do population growth, tenure insecurity, and other factors affect the length of the fallow period in the shifting cultivation system?
2. How do institutions and policies affect links between shifting cultivation and deforestation within the whole farm/whole forest context?

Studies of private and social profitability: Major land use systems in lowland Sumatra

Land use system: Agroforestry & treecrop monoculture

Specific example: smallholder rubber agroforests and smallholder rubber monoculture

*Smallholder agroforest 1 (Rubber Agroforest using **seedlings** as planting materials)*

	Revenues (Rp)	Cost (Rp)				Profits (Rp)
		Purchased inputs		Domestic factors		
		Tradable	Non tradable	Labor	Capital	
Private prices	2,055,157	460,651	166,067	1,397,684	29,144	1,611
Social prices	2,876,566	610,322	208,654	1,958,916	26,173	72,501
Effect of divergences	(521,409)	(149,671)	(42,586)	(561,232)	2,971	70,890

*Smallholder agroforest 2a (Rubber Agroforest using **clones** as planting material): An **optimistic** production scenario*

	Revenues (Rp)	Cost (Rp)				Profits (Rp)
		Purchased inputs		Domestic factors		
		Tradable	Non tradable	Labor	Capital	
Private prices	6,089,282	837,312	200,000	2,767,524	81,993	2,202,453
Social prices	8,538,408	1,008,768	208,696	3,627,439	70,931	3,622,575
Effect of divergences	(2,449,127)	(171,456)	(8,696)	(859,914)	11,062	(1,420,122)

*Smallholder agroforest 2b (Rubber Agroforest using **clones** as planting material): A **pessimistic** production scenario*

	Revenues (Rp)	Cost (Rp)				Profits (Rp)
		Purchased inputs		Domestic factors		
		Tradable	Non tradable	Labor	Capital	
Private prices	3,791,028	837,312	200,000	2,767,524	81,993	(95,615)
Social prices	5,149,816	1,008,768	208,696	3,627,439	70,931	234,228
Effect of divergences	(1,358,788)	(171,456)	(8,696)	(859,914)	11,062	(329,842)

*Smallholder rubber **monoculture**, a government project but planted with GT 1 clonal seedlings*

		***Cost** (Rp)*				
		Purchased inputs		***Domestic factors***		
	***Revenues** (Rp)*	***Tradable***	***Non tradable***	***Labor***	***Capital***	***Profits** (Rp)*
Private prices	1,869,930	649,395	200,000	1,882,598	(659,098)	(166,931)
Social prices	2,654,219	813,154	208,696	2,596,512	28,991	(993,133)
Effect of divergences	(784,289)	(163,758)	(8,696)	(713,914)	272,848	(170,769)

Team members: Prajogo Hadi and Gelar Satya Budhi

Study sites: Rantau Pandan District and Bungo Tebo District in Jambi Province; perhaps other peneplains districts of Jambi Province.

Production PAMS:
1 smallholder rubber monoculture PAM
2 smallholder rubber agroforests PAMs, of which 1 is for the Rantau Pandan site and the other is for Pelepat (or a comparable) site; planting material will be seedlings.
Additional smallholder rubber agroforest PAMs as necessary to represent major differences in technology (for example, clonal planting material), management (rubber specialists versus mixed farms), or agroforest composition (importance of fruit, timber or other species).

Discounting period for production PAMS: 25 years.

Resource degradation concerns? No.

Processing PAMS: 1 PAM, to be based on the nearest crumb rubber factory, which is only a few years old.

Regional externalities (to be noted, but not measured) in production or processing? No negative externalities for production; note water pollution or other negative externalities of processing.

Data challenges and other special features:
1. Typology of rubber agroforests. (ICRAF team can help)
2. Typology of smallholder practices in rubber agroforests.
3. Finding mature rubber monoculture. (There are plots-ICRAF team can help with locations).

Policy issues / simulations:
1. Removal of prohibitive export tax on rubber wood.
2. What limits the spread of higher-yielding clones?
3. If rubber smallholders' management practices are changing, why is that so? What effect will that have on profitability of agroforests versus monoculture?

Studies of private and social profitability: Major land use systems in lowland Sumatra

Land use system: Large-scale forest extraction

Specific example: logging in lowland dipterocarp forest

Actual annual cutting area

	Revenues (Rp)	Cost (Rp)				Profits (Rp)
		Purchased inputs		Domestic factors		
		Tradable Inputs	Tradable Capitals	Labor	Capital	
Private prices	1,437,097	102,821	834,600	240,501	389,873	(130,698)
Social prices	3,397,392	121,629	862,151	291,840	19,737	2,102,036
Effect of divergences	(1,960,295)	(18,808)	(27,551)	(51,339)	370,136	(2,232,734)

Constant annual cutting area

	Revenues (Rp)	Cost (Rp)				Profits (Rp)
		Purchased inputs		Domestic factors		
		Tradable Inputs	Tradable Capitals	Labor	Capital	
Private prices	460,619	108,812	883,227	139,569	133,447	(804,436)
Social prices	1,203,620	128,387	912,382	180,350	12,102	(31,602)
Effect of divergences	(743,002)	(19,575)	(29,156)	(42,781)	121,345	(772,834)

Team members: Machfudh and Wesman Endom

Study sites: Jambi Province, perhaps peneplains sites in adjacent provinces.

Production PAMS: At least 1 for representative concessionaire that apparently is committed to long-run production on its concession.

Discounting period for production PAMS: 25 years; note that 20 years is the current concession period. (However, the regeneration cycle is longer).

Resource degradation concerns? Need to be alert for possible depletion of resources, but the PAM is intended to represent a steady state (if that is the case). It was decided to focus on a concessionaire that is investing and managing for the long run, even if some forest depletion is happening. Although 'unsustainable' practices may be the norm, these are not very interesting for the purpose of assessing whether 'sustainable' logging is profitable.

Processing PAMS: At least 1 for an integrated processing facility.

***Large-scale forest extraction**, continued*

Regional externalities (to be noted, but not measured) in production or processing? Possible sedimentation from soil erosion during logging–especially from logging roads; note water pollution or other negative externalities of processing facilities.

Data challenges and other special features:
Identifying suitable firms and building rapport in order to gain access to necessary data.

Policy issues / simulations:
1. Trade restrictions, including prohibitive export taxes on logs and sawn timber.
2. Other forestry taxes and royalties, and fees.
3. Perverse incentives from concession period being shorter than timber harvest cycle.
4. Public policy regarding pricing of timber from natural forests.
5. Subsidised investment credits?

Studies of private and social profitability: Major land use systems in lowland Sumatra

Land use system: Annual-cropping systems on uplands of transmigration projects.

Specific example: continuous cropping of cassava, degrading to Imperata cylindrica.

Monocrop cassava with low external input application, beginning from the first year of cultivation

	Revenues (Rp)	Cost (Rp)			Profits (Rp)
		Tradable Inputs	Domestic factors		
			Labor	Capital	
Private prices	4,804,005	595,371	1,901,957	2,422,002	(71,324)
Social prices	5,632,473	950,100	2,278,692	2,718,365	(314,684)
Effect of divergences	(784,468)	(354,730)	(376,735)	(269,363)	243,360

Monocrop cassava with external input application, beginning from year 7 of cultivation

	Revenues (Rp)	Cost (Rp)			Profits (Rp)
		Tradable Inputs	Domestic factors		
			Labor	Capital	
Private prices	4,803,008	138,351	1,920,343	2,384,695	359,619
Social prices	5,764,916	346,512	2,404,975	2,788,983	224,446
Effect of divergences	(961,908)	(208,160)	(484,632)	(404,288)	135,173

Monocrop cassava without external input application

	Revenues (Rp)	Cost (Rp)			Profits (Rp)
		Tradable Inputs	Domestic factors		
			Labor	Capital	
Private prices	4,061,491	0	1,558,747	1,957,690	545,054
Social prices	4,569,727	0	1,829,010	2,137,514	603,203
Effect of divergences	(508,236)	0	(270,263)	(179,824)	(58,149)

Team members: Suseno Budidarsono (and Pratiknyo)

Study sites: Transmigration sites in North Lampung District, Lampung Province; perhaps Kuaman Kuning transmigration site in Jambi Province.

Production PAMS:
1 or more for cassava-based PAMs
1 or more maize-based PAMs
1 or more PAMs for any goods or services (e.g. roofing, grazing on shoots after burning) from *Imperata*-infested plots.

Discounting period for production PAMS: 25 years.

***Annual-cropping systems on uplands of transmigration projects**, continued*

Resource degradation concerns? Yes, at least 1 PAM (for continuous cassava) is expected to show declining production.

Processing PAMS: 1 PAM, to be based on the nearest cassava factory, which produces cassava pellets for export.

Regional externalities (to be noted, but not measured) in production or processing? There is a possibility of sedimentation from soil erosion; note water pollution or other negative externalities of processing.

Transmigration systems, continued.

Data challenges and other special features:
1. Data on effects (if any) of continuous cropping on profitability of annuals. (ICRAF staff have data from field trials; agronomic simulation models also are available)
2. Data on productivity of *Imperata* grasslands.

Policy issues / **simulations:**
1. Cassava export quotas.
2. Other trade policy restrictions.
3. Is it feasible (technically, financially, and economically) to grow annual crops continuously on the upland soils typical of Sumatra's peneplains?
4. Alternative land use systems for Transmigration settlements.
5. Technical, financial, and economic feasibility of converting *Imperata* grasslands to other uses.

Studies of private and social profitability: Major land use systems in lowland Sumatra

Land use system: Large-scale monoculture plantations

Specific example: Oil palm & industrial timber (for pulp)

Oil palm plantation

	Revenues (Rp)	Cost (Rp)			Profits (Rp)
		Tradable Inputs	Domestic factors		
			Labor	Capital	
Private prices	1,954,807	556,866	881,296	241,296	275,346
Social prices	4,116,465	848,834	1,493,440	294,595	1,479,596
Effect of divergences	(2,,161,657)	(291,968)	(612,144)	(53,299)	(1,204,246)

Team members: Retno Maryani and Irawanti Setiasih

Study sites: Jambi Province, perhaps peneplains sites in adjacent provinces.

Production PAMS:
1 oil palm PAM
1 PAM for *Paraserianthes falcataria*; also known as *Albizia falcata* ('Sengon')
Perhaps 1 PAM for *Acacia manguim*

Discounting period for production PAMS: 25 years.

Resource degradation concerns? None are known, but CIFOR is conducting long-term studies in other countries.

Processing PAMS:
1 palm oil mill PAM
1 or more pulp mill PAMs

Regional externalities (to be noted, but not measured) in production or processing? Possible sedimentation from soil erosion during logging-especially from logging roads; note water pollution or other negative externalities of processing facilities.

Data challenges and other special features:
Gaining access to data, especially for industrial timber firms.

Policy issues / simulations:
1. Import and export taxes and other trade restrictions on oil palm products.
2. Trade restrictions on imports and exports in the forestry sector.
3. Other forestry taxes and royalties, and fees.
4. Public policy regarding pricing of timber from natural forests.
5. Subsidized investment credit.