# GLOBAL ENVIRONMENT FACILITY

**MOHAMED T. EL-ASHRY**
*CHIEF EXECUTIVE OFFICER*
*AND CHAIRMAN*

May 6, 1996

Dear Council Member:

As you will recall, we circulated to Council Members on November 23, 1995, the UNDP project proposal entitled, *Global Environmental Benefits from Alternatives to Slash-and-Burn Agriculture (ASB Phase II),* which was included in the work program approved by the Council in May 1995, for comment prior to CEO endorsement. Phase I of this project was approved under the pilot phase of the GEF.

At the end of the four week review period, the Secretariat had received comments from four Council Members indicating some serious concerns about the project proposal. The Secretariat analysis of the project proposal also raised a number of concerns, some of which first arose during the review of the initial project proposal at the GEF Operations Committee.

I therefore informed UNDP that I was unable to endorse the project, and I forwarded all comments received to UNDP for its consideration.

Consequently, UNDP, working closely with ICRAF, undertook to revise the project proposal so as to respond to the concerns raised by the Council Members and the Secretariat. A copy of the revised project proposal is attached herewith for your review. Pending receipt of the Council's comments on this revised proposal, I would like to share with you my initial assessment that the revised project document seems to incorporate the substantive comments made by Council Members and that consequently the project document should now be endorsed.

A key concern that was raised with regard to the proposal was the financial sustainability of the project. Recognizing that the proposal was for the continuation of financing that was first authorized under the pilot phase, Members wanted assurances that at the end of Phase II there would be alternative sources of financing to continue any work that still needed to be undertaken to ensure the sustainability of the project's benefits. As noted on page 18 of the project document, after Phase II is completed, the project is to continue as a CGIAR system-wide program, and funding for 1997-2000 is to be supported by several CGIAR donors and national program budgets, building on the catalytic funding from GEF for phases I and II of the project. Funding has already been secured from the Ford Foundation, IDB, DANIDA and Japan.

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Another concern that was expressed by the Council when it first considered the project proposal in May 1995, was that approval of a research project prior to the adoption of the GEF operational strategy would prejudice the Council's future policy on financing research activities. In recommending this project, I would like to confirm that it will not set a precedent for future research activities which are, in accordance with the approved operational strategy, to be developed for targeted purposes within the context of the GEF operational programs, and I will specifically state this in any endorsement of the project.

If by June 3, 1996, I have not received requests from at least four Council Members to have the proposed project reviewed at a Council meeting because in the Member's view the project is not consistent with the Instrument or GEF policies and procedures, I will complete the Secretariat's assessment with a view to endorsing the proposed project document.

Sincerely,

Mohamed T. El-Ashry

cc: Alternates, Implementing Agencies, STAP

Attachment

# UNITED NATIONS DEVELOPMENT PROGRAMME
# GLOBAL PROJECT
# PROJECT DOCUMENT

| | |
|---|---|
| Title: | Global Environmental Benefits from Alternatives to Slash-and-Burn Agriculture (ASB Phase II) |
| Number: | GLO/95/G32/A/1G/31 |
| Duration: | One year |
| Primary function: | Direct support |
| Executing Agency: | Office for Project Services (UNOPS) with the International Centre for Research in Agroforestry (ICRAF) in collaboration with the ASB Consortium (See Annex A) |
| Starting date: | May 1996 |
| NARS/NGOs inputs (in kind): | $ 1 800 000 |
| IARCs Inputs: | $ 1 570 000 |

**GEF and UNDP Financing**

GEF $ 2 998 000

Total $ 2 998 000

## SUMMARY PROJECT DESCRIPTION


The purpose of the project is to 1) identify land-use practices that produce environmental benefits (sequester more carbon, reduce greenhouse gas emissions and conserve above and below-ground biodiversity) thereby limiting land degradation at the forest margins of the humid tropics, and 2) provide guidelines and analytical tools to governments and development agencies to facilitate the integration of global environmental benefits into national action plans. This terminal input of the GEF is a component of the Consultative Group on International Agricultural Research (CGIAR) Systemwide Programme on Alternatives to Slash-and-Burn Agriculture (ASB). The overall ASB Programme will be funded by non-GEF sources from 1997 to 2000. The results of the GEF Project will thus continue to be mainstreamed into the sustainable development agenda of tropical countries, thereby contributing to the specific mandate on slash-and-burn agriculture included in Chapter 11 of Agenda 21.


Africa Region: Cameroon
Latin America Region: Brazil
Southeast Asia Region: Indonesia

On behalf of Executing Agency (UNOPS) ____________________ ____________________ Date

UNDP/GEF ____________________ ____________________ Date

UNDP/STAPSD ____________________ ____________________ Date

## CONTENTS

## A. BASELINE ASSESSMENT

This document constitutes a proposal for a one-year United Nations Development Program/Global Environmental Facility (UNDP/GEF) Phase II Project to be executed by the United Nations Office for Project Services (UN/OPS) in collaboration with the International Centre for Research in Agroforestry (ICRAF) and the Alternatives to Slash-and-Burn (ASB) Consortium. The target is to assess and advise participating countries on the incremental environmental benefits of providing alternative land-use practices to unsustainable slash-and-burn agriculture at the tropical rainforest margins. The programme is supported by a variety of donors and national research budgets and operated by the ASB Consortium. The GEF provided the ASB Consortium with one-year funding in 1994 to initiate studies on incremental global environmental benefits that complement the agricultural development research of the consortium, which is funded through other sources. The achievements of this Phase I GEF Project are given in Section B and Annex B of this document. The Phase II terminal project proposed here will complete this catalytic work.

The highest levels of carbon storage and terrestrial biodiversity are currently found in tropical rainforests. The present high levels of deforestation in these areas result in significant losses in native biodiversity. These also have a negative impact on climate change through increased greenhouse gas emissions, decreased carbon sequestration and land degradation. The causes of deforestation are complex, but the margins of these forests are particularly vulnerable areas in which a major cause of deforestation is extensive forest clearance through destabilized forms of slash-and-burn agriculture that is driven by a variety of political, economic, social and biological factors. Two decades ago, the Food and Agricultural Organization of the United Nations (FAO) estimated that slash-and-burn agriculture was practised on 30% of the arable soils of the world and provided sustenance for 250 million of the world's poorest people (Hauck 1974). This practice remains the dominant land use at the margins of the humid tropical forests, and empirical evidence suggests that the numbers of people engaged in slash-and-burn agriculture may have doubled.

Global environmental benefits will be assessed in terms of first, improved carbon (C) sequestration and reduced greenhouse gas (GHG) emissions in agricultural land uses selected as alternatives to current slash-and-burn practices and second, the contribution to the conservation of forest biodiversity by the provision of land-use options that maintain high levels of this diversity.

The benefits of more sustainable agricultural practices are evidently local and national. However, they are also global since the sustainable use of the resource base of agriculture promotes the conservation of the unique plant and animal biodiversity of the moist tropical forests. The work of the ASB Programme that deals with local and national benefits is funded primarily from the Consultative Group on International Agricultural Research (CGIAR) sources. The benefits of biodiversity conservation, carbon sequestration and decreased GHG emissions are largely global and it is for these that the GEF funds are sought. A basic premise of the project is that these global environmental benefits can be achieved only through a combination of appropriate land-use practices and supportive national and global policies. Policy research is thus an important component of the proposed GEF Phase II agenda.

Little information exists on the environmental impact of agricultural land-use practices in the tropical forest zone—most existing projects have focused either on the environmental aspects of natural ecosystems or on the production aspects of agroecosystems. The GEF-funded component of the ASB Programme is unique in investigating the interface of the two approaches. A major contribution—already partially realized in Phase I—is the improved capacity of national scientists in the benchmark countries to develop and implement country action plans to realize global environmental benefits.

## A.1 Current state of the environment at the tropical forest margins

Estimates for tropical deforestation vary greatly, but commonly used figures for annual loss vary between 7 and 20 million hectares (Adger and Brown 1994). Estimates for the three benchmark countries, Brazil, Indonesia and Cameroon, are 3.7, 1.2 and 0.12 million hectares representing rates of loss of 0.6, 1.0 and 0.6 % of the forest area, respectively (FAO 1993). It has been suggested that the 200 to 500 million slash-and-burn farmers account for about two-thirds of global forest clearance annually (Myers 1994). The causes of unsustainable slash-and-burn practices are complex and are addressed under the heading of policy below. However, these cycles of land use in the forest margins often result in severely degraded lands including over 40 million hectares of alang-alang (*Imperata cylindrica*) grasslands in Southeast Asia (Garrity et al. 1994) and 20 million hectares of degraded pastures in the Amazon (Serrao 1979). Deforestation and inappropriate land use also threaten the stability of watersheds and cause downstream siltation with ultimate damage to coastal waters.

Predictions of the probable course of climate change are known to be based on inadequate data; this situation is particularly acute with respect to the estimates of emissions from the tropical regions (IPCC 1993). Data for the tropics are based on few actual measurements and include many questionable assumptions (Fearnside 1992). Current estimates are that tropical deforestation releases 1.2–3.2 billion tonnes of carbon annually (Brown 1993), contributing about one-fifth of the current total carbon loading to the atmosphere. This is second only to fossil fuel combustion (Dale et al. 1993). Among the unknowns are the type of vegetation cleared, the biomass of that vegetation, the biomass of the subsequent land-use practice, and their effects on soil carbon. There is a general assumption that clearing is from primary forest of high biomass when, in fact, much clearing and burning for agriculture is of secondary forest or even abandoned grasslands, resulting in lower carbon release to the atmosphere. There is even considerable controversy regarding the biomass of tropical forests, estimates differing by a factor of two (e.g. Fearnside 1992; Brown and Lugo 1992). It is also assumed that forest land is invariably converted to systems with low levels of carbon storage, such as annual crops and pastures. In actuality, it is becoming increasingly apparent that there are also large areas of fallow and complex agricultural systems such as multistrata agroforestry.

As with assessments of carbon stocks, there are few measurements of gas emissions from forest zone systems other than forests or pastures. In addition to the carbon released with deforestation, GHG fluxes of methane ($CH_4$) and nitrous oxide ($N_2O$) change with subsequent land use. Natural forests are known to be $CH_4$ sinks, but conversion to pasture can switch the balance to net $CH_4$ emissions (Keller et al. 1993) adding 2–4 Tg (teragrams) $CH_4$ per year to the annual global imbalance of 40 Tg (Keller et al. 1990). Conversely, forest systems may be a greater source of $N_2O$ than pastures but this probably depends on the time since clearing, and the fertility of the soil and management practices (Keller et al. 1993; Luizao et al. 1989). Conversion of forest to pastures has been estimated to account for as much as 25% of the total $N_2O$ loading to the atmosphere (Luizao et al. 1989). Most estimates of GHG fluxes from the tropics come from just a few sites, often taken only during the dry season. These measurements may give erroneous estimates of annual gas fluxes when extrapolated to different soil types, land uses and seasons.

The most authoritative statements on the global status of biological diversity are those contained in the compilations of the World Conservation Monitoring Centre ( Groombridge 1992) and the Global Biodiversity Assessment (UNEP 1995). Both reviews clearly recognize that implementation of a Global Biodiversity Strategy (WRI, IUCN, UNEP 1992) is taking place when there is inadequate information and inadequate methods for the characterization and valuation of biodiversity. For instance, estimates of extinction rate vary by orders of magnitude. Tropical rainforests are estimated to contain between two-thirds and three-quarters of the world's terrestrial plant and animal species. Among the ASB benchmark countries, the southern Cameroon forest is regarded as a major site of endemism in the Guinea-Congolian phytochorion. The Brazilian sites in Acre and Rondonia are within the main Amazonian floristic province (Prance 1989). The Sumatran forests are characteristic of the Malaysian flora of the Sunda shelf, which has been shown to have the highest alpha biodiversity in the world (Whitmore and Sayer 1992).

Many countries—including Brazil and Indonesia among the ASB benchmark sites—have introduced legislation to protect natural areas that recognizes the value of biodiversity in one or more forms. Such areas may not be fully representative of the range of biodiversity. For instance, the lowland forest of Sumatra—the major site of agricultural development—is under-represented in Indonesia's protected area. Pure conservation in large reserves is not the only means of biodiversity conservation. The adoption of sustainable and biologically complex forms of agriculture, such as agroforests, interspersed with primary and secondary forest, plantations and intensive crop fields has the potential to create landscapes with higher beta diversity than protected forest alone (Swift et al. 1996). These complex systems contribute to the maintenance of viable population sizes of a variety of forest plants and animals.

### A.2 Policy framework and influence on agriculture and conservation

The deforestation documented above has significant economic and ecological consequences. These include the costs of increasing emissions of GHG, loss of biodiversity, and loss of environmental functions such as watershed protection and soil resilience, as well as the costs borne by the people at the forest margins who derive part of their livelihoods from the forests. The driving forces of this deforestation are very complex; various authors have attempted to analyse them (Adger and Brown 1994). Government policies are an important set of such driving forces (Brown and Pearce 1994).

In the three countries where this project is implemented, different policies and institutional mechanisms have been put in place, but common threads emerge concerning the principal driving forces of deforestation.

- There is a policy and market failure in the three countries in the sense that information on the environmental values and benefits of forests and forest margins is rarely available. Therefore, decisions regarding land use at the forest margins of the three countries are made without taking these values into consideration. This results in a bias towards timber harvesting—the benefits of which are more readily apparent. Furthermore, logging concessions are granted in the three countries that improve access to forests and attract rural labour by providing temporary employment opportunities. This facilitates deforestation for food production in the vicinity of logged areas.
- Second, colonization and settlement policies in Brazil and Indonesia have resulted in road building and the transportation of migrants into relatively less populated and heavily forested areas (Amazonian Brazil and Sumatra and other islands, excluding Java and Bali, in Indonesia). These policies were originally created to better address the problems of rural poverty and regional disparities in conditions of high population pressure.
- A third theme is economic incentives (e.g. tax relief and subsidies) that exist to convert forests to specific land uses, such as pastures for cattle ranching in Brazil, or to discourage marketing of products such as rubber wood in Indonesia—this results in the burning of rubber plantations when they have passed optimal maturity.

In addition to these common policy issues, in each of the three countries there are specific policies that further contribute to deforestation.

In *Cameroon* the collapse of coffee and cocoa world market prices and the subsequent implementation of a structural adjustment programme (SAP) caused farmers to reallocate their efforts to the domestic food market. This led in turn to an accelerated rate of deforestation as farmers opened new crop fields. The small size of the domestic market, the income constraints of the continuing recession, and SAP undermined this diversification strategy, and domestic food prices collapsed as well. To further diversify their sources of income, farmers (women in particular) have turned increasingly to the gathering, processing and marketing of products from the forest including palm wine, rattan and Irvingia fruit, further increasing the pressure on the natural forest. These changes have occurred in parallel with the development of a new forest conservation policy in Cameroon built on the premise that slash-and-burn agriculture should cease. This highlights the urgent need to take into account further policy developments that include the interests of indigenous farmers in forest margins in order to manage both sides of the margins (forests and agricultural lands) sustainably and equitably.

*Indonesia* has two fundamental, but mutually inconsistent, laws on forest land use. The Basic Agrarian Law of 1960 protects the customary property rights of indigenous people dwelling in or near forest land. Yet the Basic Forestry Law promulgated in 1967 subordinates these customary rights to the government's rights to use forests—including granting forest concessions and sites for transmigration settlements and other projects. These two laws create a legal basis for overlapping claims on forest land and, thereby lead to conflicts between local people and forest production interests. This legal ambiguity creates insecurity for smallholders and large-scale operators alike and is, therefore, a disincentive to sustainable resource management in forest margins. The debate over this policy and institutional framework has been growing and has led some Indonesian officials to call for a re-evaluation of this framework (Lynch and Talbott 1995).

In *Brazil*, some of the major tax and credit incentives provided to large corporations and cattle ranchers for converting forests to pastures were eliminated in 1985 as the country suffered from recession and hyper-inflation (Moran 1993). Although rates of deforestation have indeed been decreasing, deforestation pressures are still significant. These include new demands for cleared frontier lands by urban-based land speculators—now that property rights are better protected by strengthened state governments, and ranching continues to be economically viable under current land prices (Fujisaka et al. 1995). Further policy changes can be expected as Brazil's 'green' movement strengthens. However, more reliable information about the causes and effects of current deforestation levels is needed to support positive changes.

In summary, in all three countries, major constraints are: resource-tenure policies; negative international terms of trade in humid forest zones, fluctuations in international market prices for principal agricultural commodities and timber and non-timber tree products, and lack of involvement of local communities in management of their natural resources. Policy concerns highlighted by the country specific assessments include the need to take into account the interests of farmers at the forest margins, to re-evaluate existing policy frameworks in light of ASB research findings and to continue to assess the causes and effects of current deforestation levels.

### A.3 Current scientific baseline of the ASB Programme

Assessment of the environmental impact of the recommended technologies and land-use practices has not previously been a significant part of the agenda of the agricultural research agencies. The thrust of Resolution 3 of the Biodiversity Convention has emphasised the necessity of clearly demonstrating the mutual benefits—to agricultural development and environmental conservation—of sustainable management of the forest margins. This new agenda has been acknowledged as a challenge for international agricultural research centres (IARCs) to include in their approach to research on natural resource management (Petit 1994, Seckler 1995).

The ASB Global Strategy (ICRAF 1994), a major international symposium (Sanchez and van Houten 1994) and earlier baseline papers listed in Annex C have documented in detail the substantial knowledge base of both biophysical and social science research about slash-and-burn and alternative agricultural practices. Research conducted over many decades by national agricultural research systems (NARS), CGIAR centres and other agencies has demonstrated the capacity for productive management of the forest margins (Sanchez and van Houten 1994).

Alternative agricultural systems range from intensive, high-input practices such as upland rice and maize rotations with knowledge-based fertilizer management (Smyth et al. 1995), through medium-intensity mixed cropping based on a variety of crop plants including maize, plantains and cassava (IITA 1995) and legume-based pastures (Thomas et al. 1995) to complex agroforestry systems with a variety of high-value, low-volume products (Michon et al. 1995). Much of the research in the agricultural sector now focuses on determining the relative biophysical and socioeconomic sustainability of such systems as well as ensuring, through participatory development programmes, their compatibility with the aspirations and opportunities of the farm communities. The ASB Programme will select a set of best-bet alternatives to slash-and-burn for each site. An example of the alternatives are:

- Complex agroforests, multistrata systems
- Improved tree fallows
- Contour barrier hedges on sloping lands
- Silvopastoral systems
- Acid-soil tolerant agropastoral rotations
- Low-input annual cropping systems
- Fertilizer-based crop rotations
- Legume-based pastures
- Short-term herbaceous fallows
- Irrigated lowland rice production

Development of sustainable alternatives draws on the indigenous knowledge of traditional shifting cultivators as well as incorporating science-based improvements in germplasm and management practices. Most indigenous shifting cultivation systems consist of complex polycultures with a variety of species, including trees, bushes and vines as well as annual food crops. These systems are various in form, ranging from classic swidden systems to such altered forms as complex agroforests (de Foresta and Michon 1988). The variety of plant species stimulates a high diversity of associated biota, helps to reduce the risk of diseases and pests, and provides a range of foods and other products for families. In addition, indigenous systems usually reflect complex cultural norms and traditions which often involve unique cultural knowledge of biodiversity conservation and use. Fallow stages serve as a genetic reservoir for many important plants and are a refuge for invertebrate and vertebrate animals.

Understanding features that make these environmentally sustainable forms of slash-and-burn systems stable is crucial to the search for alternatives. Increased productivity also brings the attendant danger of attracting migrants and, therefore, increasing pressure on the forest margins. Policy research is an important concern of the CGIAR system with a particular focus on food security, human nutrition and poverty alleviation. This is also a major concern of the ASB Programme, but with the unique linkage to the environmental policy aspects included in this GEF project.

The ASB Programme is designed to tackle this global issue at a sufficient scale to make a difference. GEF funding for Phase II will ensure continuation of the work on global environmental benefits that enables the overall programme to present sound policy options for national governments and development institutions. Without this GEF-funded Phase II the ASB Programme would only be able to address the agricultural and human dimensions of the problem of land use at the forest margins and thus the impact and uniqueness of this global effort would be greatly reduced. Plans for the sustainability of the overall ASB Programme beyond this terminal GEF phase are discussed in section E of this document.

### A.4 Need for incremental activities in targeted research to achieve global incremental benefits

As noted in the Global Biodiversity Assessment report, it would be extremely naive and optimistic to assume that biodiversity is automatically managed adequately when the conditions are met for agricultural development to occur (UNEP 1995 p. 1025). On the other hand, for reasons of equity, and as per the precepts of the International Convention on Biodiversity, biodiversity conservation at agricultural forest margins should not occur at the expense of farmers' livelihoods. Similarly, the draft GEF Operational Strategy recognizes that agricultural practices aimed at reducing GHG emissions and increasing carbon sequestration must also be economically and socially beneficial in order to be sustainable (Revised GEF Operational Strategy 1995 p.33).

The GEF project will result in identification of land-use practices that have been primarily assessed in relation to their potential global environmental benefits and have been found to accrue global incremental environmental benefits in terms of conserving biodiversity and minimizing the impact of climate change. Selected and recommended practices will have measurable costs (e.g. of labour) associated with carbon and biodiversity management but will also generate local agricultural benefits (e.g. more stable production). Such recommendations inevitably require some trade-offs between global and local benefits. This is why best-bet alternatives will be recommended in conjunction with implementation mechanisms that will ensure that local benefits, through appropriate policies (e.g. economic incentives on the basis of the cost-sharing principle), become sufficiently attractive for farmers to adopt the recommended practices.

## B. ACHIEVEMENTS OF GEF PHASE I

The one-year GEF Phase I project (1994–95) was evaluated in January 1995 (Eswaran 1995). The principal conclusion reached was that there was "clear indication and sufficient documentation that the Project has accomplished the objectives indicated in the Project Document for Phase I ". A summary of these achievements is given in Annex B under the main headings which the Phase I GEF project was contracted to produce. The evaluation report includes the following summary:

"The ASB project meets with many of the desired characteristics of GEF projects, namely:

- it addresses major environmental issues directly related to climate change and biodiversity conservation, and does so in a way that will improve the livelihood of resource poor people at the forest margins;
- it involves national institutions, NGOs, and international organizations as partners in the governance, financing, and implementation;
- it has been highly participatory from the start as well as gender sensitive;
- it addresses both policy and technology dimensions in a multidisciplinary manner;
- GEF funding covers incremental costs, with leverage of USD 1.4 of co-financing from participatory institutions and other donor funding for every GEF dollar received."

In addition to the specific achievements discussed below, the ASB Consortium has brought the issue of slash-and-burn agriculture into the mainstream of global concerns about tropical rainforests. Prior to securing Phase I funds, consortium representatives provided inputs to the preparatory meetings for Agenda 21 that resulted in the following recommendation in Agenda 21. Chapter 11: Combating Deforestation:

> Limit and aim to halt destructive shifting cultivation by addressing the underlying social and ecological causes.

Phase I has had an impact at various geographical levels. At the **global level**, inclusion of ASB in the GEF Pilot Phase in 1993 was in response to the enormous importance of the problem. In 1994, ASB entered the mainstream of international agricultural research when the CGIAR approved ASB as its first systemwide programme. The general public is also becoming aware of the need for ASB. Both the Cable News Network and the British Broadcasting Company have broadcast parts of a video produced by the Television Trust for the Environment that displays work at a number of ASB sites.

**Regional level.** The ASB Programme has also influenced the agenda of regional development organizations, including the Inter-American Development Bank (IDB) and the Asian Development Bank. In response to a request from the East Asia Department of the World Bank, ASB will train World Bank task managers on ASB approaches, technologies and policy formulation.

**National level.** Prior to Phase I, slash-and-burn was seldom mentioned in government issues or in the national press. The GEF Phase I caused it to become a national issue in Indonesia where there is now an intersectoral ASB committee that ensures continuous consultation between policy makers and the scientific ASB community. ASB has yet to gain this level of prominence in the agenda of other collaborating countries, although policy workshops are beginning to point in that direction and the press is giving it increased attention. ASB has been incorporated into the national agricultural research agenda of the initial collaborating countries, bringing the environmental dimension into mainstream national agricultural research.

During GEF Phase I, methods for evaluating the environmental impact of agricultural practices were developed and adopted by the ASB Consortium (Annex B, Output 1.3). Training workshops were held to develop the necessary skills in the benchmark countries (Annex B, Output 1.4). Furthermore, a number of significant results were obtained in both the biophysical and policy-related environmental activities. For instance, remote-sensing studies of the benchmark sites, co-supported by French GEF, provided direct estimates of the rates of deforestation and land-use change in the benchmark sites over the last decade. These are an improvement in the scientific baseline data for the regions. The following examples serve to further illustrate these achievements.

### B.1 Climate change

The target of research under this objective is to provide more robust data on the relative capacity of different land-use practices to sequester carbon and restrict emission of GHG. These data contribute decision-making tools that will facilitate the development of national land-use policies that combine environmental and agricultural benefits.

Clearing and burning the large biomass of tropical forests results in the release of substantial amounts of carbon dioxide ($CO_2$) to the atmosphere, often as high as 200 tonnes C $ha^{1}$. The subsequent release or sequestration of carbon following clearing and burning is related to land-use practices. Results from the measurement of carbon stocks in land-use transects in the Ebolowa site, Cameroon, show that the carbon sequestration in tree-based systems such as cacao agroforests (180 tonnes C $ha^{1}$) is more than double that of annual cropping systems, compared with 330 tonnes C $ha^{1}$ in the original forest. With fallowing, or the establishment of cacao, over half of the carbon lost upon clearing the original forest can be sequestered in 20 years. Such results provide more precise data for the Intergovernmental Panel on Climate Change (IPCC) as well as for country action plans. They can also be linked with land-cover information derived from the remote-sensing analysis and incorporated in the ASB geographic information system database to compute extrapolated carbon loss or storage rates for a range of land uses.

In Indonesia such analysis shows a net release of 6.8 and 9.0 t C $ha^{-1}$ $yr^{-1}$ since 1980 for current land uses in the Bungo Tebo and North Lampung sites. In contrast the Rantau Pandan site—dominated by maturing jungle rubber—had a net carbon sequestration of 3.1 tonnes C $ha^{-1}$ $yr^{-1}$. Data such as these for the different sites can be used for estimating the global benefits and costs of carbon sequestration of the various alternative land-use practices.

The carbon inventory studies described above, and under Output 3.3 in Annex B, provide estimates for one side of a dynamic equation of carbon and nutrient balance for any land use. Measurements of the emission of GHG give a more direct estimate of land management impacts on climate change. The primary GHG-related activity during GEF Phase I was developing and testing methods for sampling and transporting gas samples in remote locations so that a standardized method could be used at all sites. Results showed that some land-use practices can indeed maintain the $CH_4$ sink that is characteristic of natural forest systems while others diminish that sink and may even be a net source of $CH_4$. Preliminary results for $N_2O$ emissions show higher emissions from forests than from agricultural systems without fertilization.

### B.2 Biodiversity

The Global Biodiversity Assessment (UNEP 1995) has highlighted many gaps that exist in current evaluations of the state of the world's biological resources, even at the simplest level of inventory. The Phase I GEF Project Document did not contract any specific biodiversity outputs, but the ASB Consortium initiated work to address this objective during 1994 and 1995. The initial target is to develop rapid assessment methods for inventory of the biodiversity of different land uses. This will enable assessment of the relative value of conservation of different land-use mosaics at the landscape scale. A second target is to investigate the capacities of different practices to sustain native biodiversity. ASB has a unique approach in that it is combining measurements of both above and below-ground biodiversity and linking them to carbon sequestration and GHG emissions. The Global Biodiversity Assessment commented specifically on the paucity of knowledge related to the below-ground component of the biosphere despite its important functional roles in all ecosystems (UNEP 1995), including those of GHG mobilization.

ASB teams, led by the Centre for International Forestry Research (CIFOR) and the Tropical Soil Biology and Fertility Programme (TSBF), have developed draft protocols for rapid assessment of vegetational and below-ground biodiversity, respectively (Annex B, Output 1.3). A study of plant diversity in agricultural systems in the Brazilian sites showed that, although overall diversity was much higher in the forest, plant diversity was often high in cropping systems and fallows (with regrowth of some forest species, but also the appearance of species not found in the forest) and low in pastures. When cropping persisted for more than two years, diversity decreased significantly.

A larger-scale vegetational analysis in the Western Amazon Basin has revealed a similar picture. Significant relationships were demonstrated between land-use practices and plant diversity measured taxonomically. There was a general decline in both taxonomic and functional richness in all agricultural plots compared with the forest. The most interesting result, however, was a significant jump in biodiversity about two years after the abandonment of homegarden plots. This suggests that recolonization is a fairly rapid event. Pastures were again the least diverse land uses.

Below-ground biodiversity is also strongly influenced by forest clearing and land-use change. No studies of below-ground biodiversity were undertaken by ASB in Phase I other than the development of a protocol by TSBF. Phase II work can, however, build on previous studies made by ASB contributors that show that in intensive agricultural practices and pastures the diversity of many groups of the soil fauna—including important functional groups such as the termites—is greatly reduced as compared with either primary or secondary forests (Lavelle and Pashanasi 1995). Tree-based agricultural systems have significantly higher diversity and biomass of soil fauna than those based solely on annual crop species.

Indeed, one of the key outcomes of previous research by the Institut française de recherche scientifique pour le développement en cooperation (ORSTOM) and the Southeast Asian Regional Centre for Tropical Biology (BIOTROP) on which Phase II will build upon, is that complex agroforests—such as the complex multistrata rubber and damar agroforests in Sumatra—present a very high level of biodiversity while being profitable for farmers. These are indigenous land-use systems that ASB strongly believes are realistic alternatives to slash-and-burn, particularly for the forest margins, but also for reclamation of degraded land such as the imperata grasslands that are themselves an end product of slash-and-burn in much of Southeast Asia.

In these studies, plant diversity was found to be 60% in mature jungle rubber agroforests in Sumatra, compared with 100% in primary forest and 0.5% in rubber strata. The richness of bird species in mature damar *(Shorea javanica)* agroforest was 50% that of the original rainforest and all mammal species are present in the agroforest. Tracks of the rare Sumatra rhino were recently discovered in the damar agroforest, implying that these agroforests may provide a habitat similar to the natural rainforest.

This is possible because such agroforests—composed of hundreds of small plots managed by individual families—occupy contiguous areas of several thousand hectares in Sumatra. The development of complex agroforest corridors may be one of the most attractive options for biodiversity conservation in areas of active deforestation.

### B.3 Policy studies

During Phase I, analysis of current policy issues has been conducted for two of the benchmark countries (Annex B, Output 3.2) together with assessments of the factors determining environmental and agricultural change (Outputs 2.1, 2.2 and 3.1). The ASB Consortium was also able to draw upon this information base, and its own collective expertise, to assist in the analysis of specific policy problems. The previously mentioned two fundamental but mutually inconsistent laws on forest land use in Indonesia allow overlapping claims over forest land and, thereby, lead to conflicts between the customary claims of local people and forest production interests.

During Phase I, the ASB Consortium held a workshop on agroforestry approaches to the reclamation of degraded imperata grasslands of Southeast Asia in Banjarmasin, Indonesia. This was followed by a one-day seminar with the Minister of Forestry, his senior staff and ASB partners. The Minister of Forestry has requested ASB advice in framing an appropriate institutional, regulatory and policy reform for removing the current contradictions in the legislation. Implementation of this reform should lead to decreased land degradation and increased biodiversity conservation by smallholders and, therefore, to global environmental benefits.

## C. DEVELOPMENT OBJECTIVE

The overall goal of the project is to identify and develop alternatives to slash-and-burn agriculture in tropical forests that will have global environmental benefits—a reduction in the net emission of GHGs and the conservation and productive use of biodiversity.

## D. THE PHASE II GEF PROJECT (IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES)

The Phase II plan of work for the GEF-funded component of the ASB Programme is directed at three goals: 1) assessment of the climate-change implications of various land-use systems at tropical forest margins, 2) assessment of the impact on biodiversity of different land uses, and 3) linkage of environmental benefits to agricultural development. The activities and outputs of the first goal relate to the evaluation of carbon sequestration and GHG emissions of current and alternative practices to slash-and-burn. The activities and outputs of the second goal similarly relate to evaluation of biodiversity losses and levels. The third goal results in the recommendation to national governments, donors and development agencies of alternative practices to slash-and burn that generate global environmental benefits, together with guidelines and analytical tools for framing country action plans to implement such recommendations. A supporting activity is the coordination function that manages the project and liaises with the various partners and the development agencies.

### D.1 Goal 1: Assessing the climate-change implications of alternative land-use practices

The measurement of the total carbon stocks in forest and current and alternative land-use practices in the benchmark areas provides an improved empirical base for estimating current —and predicting future—carbon losses and sequestration at the tropical forest margins. These estimates permit the rigorous assessment of the relative environmental costs and benefits of alternative land-use practices. The data will also be incorporated in dynamic models that will provide decision makers with tools for predicting the impact of various land-use change scenarios.

Evaluation of sources and sinks of $CH_4$ and emissions of $N_2O$ and $CO_2$—using the sampling method established during Phase I—will be made in forests and various land-use practices representing different levels of carbon sequestration and degrees of management. This will provide better data that can be used in environmental assessments of the land-use practices. These numbers can also be used for the national inventories required by IPCC and will be valuable for the International Global Atmospheric Chemistry (IGAC) Project on gas exchange in the tropics related to land use. Their scale models will allow analysis of the global effects of land use on gas emissions.

Assessments of carbon stocks and gas emissions are required by the IPCC for the national $CO_2$ emissions inventories. The IPCC is drafting a new protocol to assess national $CO_2$ emissions from vegetation and soils and has expressed an interest in having some of the ASB sites test these methods.

***Objective 1: To determine those land-use systems that sequester more carbon, reduce greenhouse gas emissions, and slow deforestation and subsequent land degradation for each of the benchmark countries.***

*Output 1.1: Strategic information on changes in carbon stocks with land use*
Strategic information for decision making, and for use in country inventories required by IPCC guidelines on the application and adoption of environmentally sound land-use systems, through databases on relative and absolute carbon storage for current and best-bet alternative land-use systems and system components (e.g. crops, forages, trees).

Activities

- Evaluation of carbon stocks (above and below-ground) in current slash-and-burn systems and best-bet alternative practices already being tested (outside of the GEF activities) at various locations, both on farmers' fields and on research stations.
- Evaluation of various components relevant to the above-mentioned practices at each benchmark site ( e.g. crops and crop varieties, forage grasses and legumes, trees and shrubs) for their above and below-ground biomass and rooting depth.
- Integration of carbon storage values for various land-use systems with remote-sensing data on the areal extent and changes of these systems in the benchmark areas. This data will be used to calculate current and predicted carbon emissions.

*Output 1.2: Database on greenhouse gas emissions from different land-use practices*
A database on sources and sinks of $CH_4$ and emissions of $N_2O$ and $CO_2$ from current slash-and-burn practices at the benchmark sites and of alternative best-bet options being tested. The information will provide strategic inputs to decision making on the application and adoption of environmentally sound land-use systems and contribute to country inventories required by IPCC guidelines and other projects of the global change community (IGAC and GCTE).

Activities

Measurement of $CO_2$, $N_2O$, and $CH_4$ fluxes from selected current and alternative land-use practices. At some of the sites, e.g. Indonesia, intensive measurements will be made to include seasonal and daily fluctuations in gas fluxes. At the other sites emissions will be measured from a range of systems to provide a more complete inventory. This information is needed to assess the environmental costs and benefits of current land uses in the benchmark countries and to predict various land-use scenarios when integrated with data on land uses at different spatial scales

*Output 1.3: Assessment of land-rehabilitation techniques for increasing carbon sequestration*

Techniques for the rehabilitation of degraded lands for productive use, with particular focus on increasing carbon sequestration, e.g. in alang-alang grasslands in Indonesia and degraded pastures in Brazil.

Activities

Selection of plants including trees, shrubs, forage species, and cover crops for enhanced carbon sequestration in the degraded lands.

Implementation of field management practices and systems for the establishment of these selected species in degraded lands.

*Output 1.4: Expertise in evaluating carbon sequestration and GHG emissions*

National scientists trained in the evaluation of carbon sequestration and GHG emissions.

Activities

- Distribution of sampling methodologies and equipment at the benchmark sites
- On-site training at the benchmark sites
- South–south collaboration among national scientists, with Indonesian scientists from the Agricultural University of Bogor, Indonesia (IPB) coordinating GHG measurements at the different sites.

## D.2 Goal 2: Assessing the impact of different land-use practices on biodiversity

The main target of study under this goal is to develop inventories of the vegetation and selected taxa of the associated above and below-ground biota for forest and representative land-use systems. Traditional agricultural practices, including much of slash-and-burn agriculture, are not homogeneous and vary greatly in structure, species composition and associated biodiversity. Many practices utilize native biodiversity to provide forest products for households and markets in a sustainable way and to assure rapid restoration through natural fallows. However, conventional wisdom holds that forest conversion to agriculture inevitably leads to substantial losses in biodiversity.

A recent review of the state of knowledge concerning the magnitude and distribution of biodiversity stresses that past work has concentrated on global and regional assessment and that “assessment of local diversity and its relationship to the landscape scale is called for” (UNEP 1995, p.164). During the GEF-funded Phase I, measurement of the local vegetational diversity levels of current land uses—including indigenous practices in forest margins—was initiated. With the exception of the complex agroforests of Sumatra, little is known about the local biodiversity levels of best-bet alternatives to slash-and-burn agriculture. Goal 2 aims to fill this gap, thereby providing policy makers and decision makers with essential information for developing sustainable biodiversity management policies and country action plans. In addition, this information will increase the reliability of country biodiversity inventories.

***Objective 2: To assess the impact on biodiversity of various land uses including current slash-and-burn practices, to determine patterns of land use that best support biodiversity, over and above current practices.***

*Output 2.1: Rapid assessment tools for biodiversity*

Protocols for the rapid assessment of above-and below-ground biodiversity at the plot and landscape levels.

Activities

- Finalization, testing, and dissemination of protocols for biodiversity assessment at the field and landscape scales. Validated methods applicable to rapid assessment of species richness in a variety of land-use practices will be included for the vegetation and selected taxa of the soil biota (nitrogen-fixers, mycorrhizae, termites, earthworms, nematodes). Evaluation of the use of indicator species and other surrogate techniques will also be included.

*Output 2.2: Development of biodiversity assessment database and models*

Database and models on the relationship between native biodiversity loss and conservation, current management practices and best-bet alternatives to slash-and-burn. This information will provide strategic inputs for decision making to reduce the impact on biodiversity and will also contribute to country biodiversity inventories.

Activities

- Assessment of above and below-ground biodiversity at the plot and landscape level based upon the species richness and absence or abundance of selected taxa associated with current and alternative best-bet land-use practices. The main focus will be on plant and below-ground taxa, but selected taxa of above-ground fauna will be inventoried where possible.
- Development of spatially referenced databases concerning the impact of different land-use practices on biodiversity.

*Output 2.3: Techniques for restoring native biodiversity*

Techniques for rehabilitation of degraded lands to productive use and enhanced biodiversity (e.g. of alang-alang grasslands in Indonesia and degraded pastures in Brazil).

Activities

- Selection of plants including indigenous trees, forage species and cover crops for sustainable enrichment of biodiversity in degraded lands.
- Implementation of field management practices for the introduction and establishment of these selected species in degraded lands.

*Output 2.4: Biodiversity assessment expertise*

National scientists trained in methods for assessment of above and below-ground biodiversity at plot and landscape scales.

Activities

- On-site training in biodiversity assessment protocols and techniques of land rehabilitation.
- Training of scientists in the use of spatially referenced data, relevant to biodiversity and habitat protection.

### D.3 Goal 3 Linking environmental benefits to sustainable alternatives to slash-and-burn agriculture

The sustainable management of biodiversity, carbon sequestration and GHG emissions outside of designated conservation areas and in tropical forest margins, where various pressures (e.g. poverty, population) threaten natural resources and local livelihoods, requires the integration of environmental and agricultural development concerns. While concepts and methods exist for this integration, past work has largely been theoretical with very limited practical applications relevant to the tropical forest margins (Barbier et al. 1994; Adger and Brown 1994). One of the intents in goal 3 is to apply these existing techniques to the identification of those best-bet alternative practices to slash-and-burn agriculture that generate substantial global environmental benefits.

The ultimate success and long-term sustainability of any improved land-use practice will depend on the effectiveness of the policy environment in facilitating adoption of these practices by the resource-poor farmers and indigenous people who draw their livelihoods from the use of the forests and cultivation at the forest margins. A second intent in goal 3 is, therefore, to identify policy options and institutional reforms appropriate to this facilitation, as well as their implementation mechanisms, and to integrate these in country action plans and environmental policies. This identification (which was initiated during Phase I) is undertaken in a participatory and demand-led fashion with relevant policy makers, natural resource managers, NGOs and donor agencies in the environmental conservation and agricultural-development fields as well as land users and local decision makers. In addition, in some pilot areas (e.g. buffer zones in Indonesia) ASB facilitates the development of community-participation schemes for transferring the recommended sustainable practices to resource-poor farmers. The basic principle underlining the work in goal 3 is that of equitable sharing of the costs and benefits of sustainable biodiversity and climate change mitigation among various groups in society.

***Objective 3.1: To produce recommendations of those alternatives to slash-and-burn practices best suited to integrating environmental benefits and sustainable agricultural development and to select those policies, institutional frameworks, and their implementation mechanisms that facilitate the adoption of these recommended land-use practices (with definable global environmental benefits).***

*Output 3: Recommendations that link global environmental benefits to land-use practices*

An annotated database for decision makers on alternatives to slash-and-burn practices. This will state the respective costs and benefits in terms of climate change and biodiversity of sustainable agricultural outputs, for 1) individuals farmers implementing the practice, 2) national societies, and 3) the global society.

Activities

- Assemblage and prioritization at each benchmark site of alternatives to slash-and-burn in terms of sustainable agriculture and as a basis for environmental assessments.
- Collation and analysis of environmental impact assessments with existing data on agricultural productivity and sustainability of current and alternative land-use practices.
- Integratation of datasets in a GIS to assess the environmental impact of alternative land-use scenarios at the different spatial scales.

*Output 3.2: Development of policy interventions to facilitate the adoption of recommended land-use practices*

Recommendations to relevant stakeholders of resource tenure systems, institutional frameworks, and environmental policies that facilitate the implementation of the recommended land-use alternatives for the forest margins and their degraded lands.

Activities

- Review and analysis policy options and recent institutional experiences relevant to the recommended alternative land uses.
- Facilitation of community participation schemes for adopting alternative practices in selected pilot areas.
- National workshops and consultations with relevant stakeholders and policy makers for policy and institutional reforms necessary for the adoption of recommended alternative practices.

*Output 3.3: Development of Tools for the development and implementation of country action plans*

Guidelines and analytical tools to develop country action plans to implement the identified land-use practices; policy makers and land-use decision makers to be made familiar with these analytical tools.

Activities

- Preparation of policy briefs for relevant stakeholders for integrating biodiversity conservation and climate change mitigation in agricultural development in tropical forest margins, and for implementing this integration through appropriate economic incentives and institutional policy reforms.
- Consultation with national policy makers, land-use planners, land users, and natural resource managers in the benchmark countries to initiate the framing of country action plans, or the relevant amending of existing plans.

## E. ASB PROGRAMME SUSTAINABILITY BEYOND GEF'S PHASE II

### E.1 Programme strategy

The ASB Programme is an on-going, systemwide CGIAR programme of which the GEF-funded project is an important component. The overall ASB Programme is an outcome of the Inaugural Workshop held in Rondonia, Brazil, in February 1992. It has a long-term strategy that includes a planning stage and three research phases.

The planning stage involved formulation of goals, objectives and research strategy; identification of partners; site selection, and workshops for the development of characterization guidelines and other research protocols.

The first ASB research phase involved a scientific baseline assessment (multiscalar characterization and inventories of biophysical, socioeconomic and policy factors).

The second phase of the overall ASB Programme involves the collection of additional data on environmental impact and policy factors affecting agriculture and forest use, and the analysis and synthesis of the combined data collected in the first and second research phases. This will enable the ASB Consortium to identify 1) the domains of slash-and-burn activities as defined by vegetation type cleared, origin of people practising slash-and-burn, and the eventual land use; 2) the driving forces of deforestation and biodiversity loss as they relate to the biophysical, socioeconomic, and policy environment; 3) land-use practices that conserve or increase biodiversity, increase carbon sequestration and reduce GHG emissions; 4) the combined environmental-economic value of alternative land-use practices, and 5) the policy instruments necessary for adoption of these practices.

The third and final research phase is the development of national action plans based on the selection of alternative land-use practices and policies derived from participatory on-farm testing, environmental assessment and policy analysis. These action plans are the mechanism through which the ASB Programme research results will be mainstreamed into the policy and planning environment where they will be able to realize the kind of environmental and human welfare goals for which the ASB Programme was created.

To cover the crucial environmental component of the ASB Programme, the ASB Consortium developed a proposal for GEF, through UNDP, for environmental research activities. This was to complement the CGIAR-supported activities in the area of agricultural development and human welfare. The USD 3 million funding for Phase I of the GEF-funded ASB Project (January 1994 to June 1995) was used to implement activities designed to produce global environmental benefits as described in Section B of this document.

Since the end of this GEF Phase I in July 1995, money has not been available for continuation of the global environmental benefits activities. However, work in the area of agricultural production and human welfare has continued.

The proposed Phase II GEF activities will generate the information and methods that will provide the tools and capacity for developing, implementing and assessing the country action plans. The overall ASB Programme will continue beyond GEF funding and will carry out work on both the remaining evaluation of global environmental benefits and the food security and rural welfare dimensions of the programme.

As a continuation of the mainstreaming of results from the three research phases, activities after 1996 will also focus on extension and extrapolation of recommended practices. The ASB Consortium is not intended to be the primary extrapolation agent but will provide the information, tools, and training for extrapolation to the appropriate agencies. A strategy for monitoring and impact assessment will be an integral part of the extrapolation mechanism. Linkages with development projects at the tropical forest margins, supported by national governments and donor organizations, will be the end result of the ASB Programme, which is envisioned to end by the year 2000.

### E.2 Funding strategy

A long-term, phased, and multi-institutional programme such as ASB requires a diverse funding strategy. The conceptualization and planning stages through 1992 and 1993 were funded by UNDP with contributions from the core budgets of some of the international partners. These funds, together with inputs from UNEP and other donors, also assisted in the first field work on site selection and characterization. Subsequently, the major part of the agricultural development studies has been funded through the normal mechanisms of the CGIAR and national research institutions. GEF provided USD 3 million dollars for Phase I that enabled the establishment of the ASB Consortium, the Global Coordination Unit at ICRAF and the initiation of global environmental benefit studies. The total cost of the ASB Programme from 1992 to 1995 was estimated at USD 9.7 million from the various sources, including GEF Phase I.

The GEF-funded Phase II component will not involve expansion to additional sites, but linkages have already been established with ASB Programme sites in Peru, Thailand and Mexico, co-funded by a variety of donors including IDB, the Ford Foundation, Denmark (DANIDA), and Japan. These activities will continue without funding from GEF.

ASB will continue as a CGIAR systemwide programme, and funding for 1997–2000 will be supported by several CGIAR donors and national programme budgets, building on the catalytic funding from GEF. Funding has already been secured from the Ford Foundation, IDB, DANIDA and Japan for activities in 1996–7.

As part of the ASB Programme's long-term fund-raising strategy Denmark organized an ASB Donor Consultation Meeting in Kampala, Uganda on 6 February, 1996. Participants as representatives of donors to the CGIAR agreed to seek additional contributions to this systemwide programme for 1997–2000. Two multilateral and six country donor organizations expressed interest in supporting components of the ASB Programme. As a continuation of this fund-raising process a second ASB Donor Consultation Meeting will be held in Jakarta during the CGIAR Mid-Term Meeting in May 1996.

### E.3 Management strategy

The ASB Programme is designed to ensure full participation of partners in the programme planning and implementation. It involves a total of 15 national programmes, international research centres and NGOs. These form the ASB Consortium and Consortium members are represented on the Global Steering Group (GSG) that meets annually. ICRAF is the ASB coordinating institution; the Director General chairs the GSG and the ASB Global Coordinator operates from ICRAF headquarters.

Regional coordinators are responsible for activities in the three programme regions: Africa, Southeast Asia and Latin America. The NARS directors chair the national steering groups, which consist of national government officials, national research and extension institutions, NGOs and universities. These groups ensure national government involvement and support, set guidelines for policy research and foster linkages with country action plans. The NARS-ASB representative chairs the local steering groups made up of farmer-producer organizations, NGOs, community leaders, state governments and researchers from NARS and international centres and programmes. These groups implement the project goals at the local level and maintain the quality of research and the execution of training and dissemination activities and develop links with development projects operating at the sites.

This management structure has also been the framework for implementation of the ASB GEF-funded Project. However, the management structure for GEF Phase II has been streamlined, with the elimination of the regional coordination mechanism. Three scientific leaders support the ASB Coordinator by overseeing quality and the delivery of the three goals of this GEF project indicated in section 3 of this proposal. That is: ameliorating climate change, management of biodiversity, and linking of global environmental benefits to sustainable alternatives to slash and burn.

### E.4 Dissemination of results and recommendations through country action plans

Although the activities of the second phase of the GEF-funded ASB Project are designed to produce a number of significant results, the long-term strategy is to integrate these results into country action plans in order to ensure that they have a real impact. The results of ASB research activities in Indonesia are already beginning to have an impact on national action plans and budgets. This rapid success in Indonesia, though welcome, is not the norm, institutional and policy change is generally a slow process, as has been experienced in Brazil and Cameroon. Therefore, the dissemination of research results produced with GEF funding, through publications and workshops together with national and regional policy workshops will be included in the overall ASB Programme Strategy for 1997–2000.

As another part of the ASB Programme Strategy to ensure the mainstreaming of research results from the GEF-funded Project, ASB will continue to work with the regional development banks as well as the World Bank, to include ASB results into their projects in the forest margins. ASB will seek links with ongoing GEF projects and communicate its findings to the implementing agencies as well as to the organs of the Biodiversity and Climate Change Conventions and the Inter Governmental Panel on Forests of the Commission on Sustainable Development. Public awareness efforts will continue and will have the assistance of the CGIAR public awareness systems.

## F. INPUTS

### F.1 UNDP input

The budget for the GEF contribution to this project is summarized in the attached Budget Table 1. The budgetary details of the subcontract with ICRAF are contained in Budget Table 2.

### F.2 Slash-and-Burn Consortium input

ASB's partner institutions have committed USD 3.37 million in co-financing (Table 2). This is equal to the amount requested in this proposal to GEF. Commitments have been made by each institution in terms of allocated time and number of scientists actively participating in ASB at each site. It is important to note that the 28.6 senior staff years (SSY) provided by NARS and NGOs are funded from their own resources to a total of USD 1.8 million. For NARS and NGOs, UNDP/GEF funds support only travel and operational costs and short-term consultants where needed. In a similar fashion, international institutions have allocated senior staff time and services valued at USD 1.57 million in support of the ASB Phase II programme.

## G. RISKS

The success of sustaining the national mechanism and process established during the execution of the programme will depend on the positive perception of the national governments and non-governmental stakeholders of the benefits of ASB. By integrating national benefits in the design and implementation of ASB and by identifying implementation responsibilities within existing national institutions, it is more probable that the participating countries will take over the mechanism and process introduced during the programme and allocate local resources to continue them. By including the non-governmental sector in the programme, public involvement is maximized. By promoting South-South co-operation and strengthening regional institutions, the programme creates an environment for regional co-operation.

In addition, the research methods and databases developed during Phase I and expanded during the Phase II will make the project replaceable in a cost-effective manner and will allow other institutions and programmes to leverage other funds to increase the scope of its implementation.

## H. PRIOR OBLIGATIONS AND PREREQUISITES

There are no prior obligations. The prerequisite for participating countries is that national governments commit to support the programme and follow the programme guidelines. In particular, the participating countries should make the following contributions:

- assist with logistical arrangements (provide facilities for research, workshops, internal travel, etc.)
- provide staff time of national experts
- designate focal points and assist in further networking
- involve a cross section of sectors, to include NGOs, the private sector, industry, etc.
- assist in the follow-up processes envisioned by the programme.

This agreement will be formalized in the ASB-ICRAF subcontracts with each country.

The project document will be signed by UNDP, and UNDP assistance to the project will be provided, subject to UNDP receiving satisfaction that the prerequisites listed above have been fulfilled or are likely to be fulfilled. When anticipated fulfilment of one or more prerequisites fails to materialize, UNDP may, at its discretion, either suspend or terminate its assistance.

## I. PROJECT REVIEWS, REPORTING AND EVALUATION

The proposed operational framework shown in E.3 ensures timely and thorough monitoring and evaluation of progress from the local level through national and global level steering groups.

In addition, the five IARCs have a standard review procedure, which starts with the Programme Committee of the Board of Trustees, goes through the programme leaders and coordinators within each institution, and then through the Director General's office.

ICRAF, as the global coordinating institution, will monitor research progress and budget expenditures regularly with NARS collaborators and the ASB Consortium.

All IARCs publish yearly programme reports and highlights of their research and international programmes. Individual scientists will report significant findings through international journals and meetings.

There will be an independent evaluation of Phase II very near the end of 1996. Six-monthly progress reports will be presented by the ASB Coordinator to UNDP.

There will be a tripartite review in connection with the Global Steering Group meeting in 1996.

## J. LEGAL ASPECTS

This project document shall be the instrument referred to as such in Article 1, paragraph 1, of the Basic Assistance Agreement between the United Nations Development Programme and the governments of those participating countries that have signed such an agreement. Alternatively, for those participating countries that have not signed such an agreement, this project document shall be the instrument referred to as a plan of operation in Article 1, paragraph 2, of the agreement concerning assistance under the Special Fund Sector of the United Nations Development Programme, between the UNDP and the governments of those participating countries that have signed such latter agreement.

## K. BUDGET

The UNDP budget and the details for the ICRAF subcontract are attached.

Table 1. SENIOR STAFFING PATTERN (For Phase II GEF funding)

| ORGANIZATION | TIME/POSITION SENIOR STAFF YEAR (SSY) | NAME | LOCATION |
|---|---|---|---|
| CIAT: | 0.2 SSY Agropastoralist | Michael Thung | Acre, Brazil |
| | 0.2 SSY Anthropologist | Sam Fujisaka | Cali, Colombia |
| IITA: | 0.5 SSY Policy economist | To be named | M'Balmayo Cameroon |
| IFPRI: | 0.5 SSY Policy economist | Steve Vosti | Washington, USA |
| ICRAF: | 1.0 SSY Global coordinator | Dale Bandy | Nairobi, Kenya |
| | 0.17 SSY Agroforester | Carlos Castilla | Rondonia, Brazil |
| | 0.8 SSY Nat'l resource economist | Thomas Tomich | Bogor, Indonesia |
| | 0.50 SSY Soil scientist | Meine van Noordwijk | Bogor, Indonesia |
| | 0.17 SSY Environmental Economist | Anne Marie Izac | Nairobi, Kenya |
| | 0.50 SSY Agroecologist | John Corbett | Nairobi, Kenya |
| TSBF: | 0.1 SSY Soil Biologist | Mike Swift | Nairobi, Kenya |
| | 0.5 SSY Soil Biologist | Paul Woomer | Nairobi, Kenya |
| | 0.4 SSY Soil Ecologist | Cheryl Palm | Nairobi, Kenya |
| IFDC | 0.1 SSY Soil Scientist | Walter Bowen | Muscle Shoals, Alabama |
| CIFOR | 0.2 SSY Ecologist | Andy Gillison | Bogor, Indonesia |
| | 0.1 SSY Policy Economist | David Kaimowitz | Bogor, Indonesia |

**Table 2.** **Slash-and-Burn Consortium Co-financing based on Senior Staff Years (SSY) and in -kind contributions**

| | IN KIND CONTRIBUTIONS (US$,000) | | | | | |
|---|---|---|---|---|---|---|
| **INSTITUTION** | **SSY** | **BRAZIL** | **CAMEROON** | **INDONESIA** | **GLOBAL** | **TOTAL** |
| **NARS/NGOs** | | | | | | |
| EMBRAPA | 10.5 | 460 | | | 200 | 660 |
| AARD | 11.0 | | | 550 | 240 | 790 |
| IRA | 6.5 | | 230 | | 60 | 290 |
| PESACRE | 0.2 | 20 | | | | 20 |
| IPHAE | 0.2 | 20 | | | | 20 |
| INADES | 0.2 | | 20 | | | 20 |
| **SUB-TOTAL** | **28.6** | **500** | **250** | **550** | **500** | **1800** |
| **IARCs** | | | | | | |
| IFDC | 0.2 | 20 | | | 20 | 40 |
| IFPRI | 0.6 | 100 | | | 50 | 150 |
| CIAT | 0.8 | 60 | | | 60 | 120 |
| CIFOR | 0.6 | | | 100 | 50 | 150 |
| IITA | 1.0 | | 100 | | 50 | 150 |
| TSBF | 0.6 | | | | 100 | 100 |
| ICRAF | 4.0 | 70 | 100 | 80 | 210 | 460 |
| ICRAF-CIRAD | 1.5 | | | 50 | 300 | 350 |
| ICRAF-ORSTOM | 0.5 | | | 50 | | 50 |
| **SUB-TOTAL** | **9.8** | **250** | **200** | **280** | **840** | **1570** |
| **GRAND-TOTAL** | **38.4** | **750** | **450** | **830** | **1340** | **3370** |

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ASB | Alternatives to slash-and-burn |
| $CO_2$ | Carbon dioxide |
| CGIAR | Consultative Group on International Agricultural Research |
| $CH_4$ | Methane |
| CIFOR | Centre for International Forestry Research (Bogor, Indonesia) |
| CFA | Cameroon franc |
| FAO | Food and Agricultural Organization of the United Nations (Rome, Italy) |
| GCTE | Global Change in Terrestrial Ecosystems Programme |
| GEF | Global Environmental Facility |
| GHG | greenhouse gas/es |
| GSG | Global Steering Group |
| ha | hectare |
| IARCs | International Agricultural Research Centres |
| ICRAF | International Centre for Research in Agroforestry |
| IDB | Inter-American Development Bank |
| IGAC | International Global Atmospheric Chemistry |
| IPB | Agricultural University of Bogor (Indonesia) |
| IPCC | Intergovernmental Panel on Climate Change |
| IUCN | The World Conservation Union |
| $N_2O$ | Nitrogen oxide |
| NARS | National Agricultural Research Systems |
| NGO | non-governmental organization |
| SAP | structural adjustment programme |
| t | tonne, metric ton |
| tg | teragram |
| UNDP | United Nations Development Program (New York, USA) |
| UNEP | United Nations Environment Program (Nairobi, Kenya) |
| UNOPS | United Nations Office for Project Services (U.S.A.) |
| USD | United States dollars |
| WRI | World Resources Institute (U.S.A.) |

## ANNEX A:

# ASB CONSORTIUM - PHASE II

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ANNEX B:

# Alternatives to Slash-and-Burn , GEF Project

## Achievements of Phase I

A brief summary of results from the GEF-funded Phase I Project of the ASB Programme is given below under the Expected Outputs as contracted in the Phase 1 Project Document agreed by the GEF Council in November 1993. Detailed quantitative results are available in the Project Reports. The outputs are grouped in relation to three main components of the Phase I Workplan.

### A. Project implementation

The four outputs under this heading provide the base on which the rest of the project rests, in particular the mechanisms for establishing the interface between the environmental and agricultural research and for ensuring comparability between sites.

***Expected Output 1.1 Interdisciplinary teams established at each location.***

*Results*

The research scientists at the benchmark sites form interdisciplinary teams that in all cases go beyond the normal profile for agricultural research, in terms both of discipline and of institutional allegiance. For example, of the 53 scientists working in Indonesia, 15 are environmental scientists and foresters; Universities and a regional environmental institute (BIOTROP) lead three of ten research activities. In both Indonesia and Cameroon peer review systems were set up to allocate GEF funds to research activities; in Indonesia eleven of 23 agreed activities in Phase I were related to land-use change, climate change and biodiversity, six to policy options and only four addressed agricultural questions. Similarly in the Cameroon, agricultural scientists with the Institut de recherché agronomique collaborated with vegetation ecologists (Universite de Yaounde), plant taxonomists (National Herbarium, National Museum) and wildlife conservation groups.

***Expected Output 1.2. Publication of guidelines for site characterization and setting of research priorities.***

*Results*

A manual of standard methods, *Procedural guidelines for characterization* (Palm C. Et al. 1995) incorporating socioeconomic, ecological and agricultural techniques was published and distributed to all ASB cooperators. These methods have been used to establish the essential baseline of comparability between sites both within the project and with areas being studied by other groups (e.g. in GCTE).

***Expected Output 1.3 Manuals for standard methods, procedures and protocols for project implementation.***

*Results*

A series of six protocols of methods for research on climate change and biodiversity have been prepared. In some cases (e.g. biodiversity) the manuals incorporate innovative approaches developed within the ASB Consortium. Manuals were completed and distributed to the benchmark sites on (i) carbon balance assessment; (ii) limiting nutrient identification; and (iii) adaptation of the CENTURY Ecosystem Carbon Simulation Model to forest conversion by slash-and-burn agriculture. Environmental assessment protocols in advanced stages of preparation address (iv) GHG monitoring; (v) plant functional attributes for biodiversity comparisons between benchmark sites; and (vi) measurement of soil biodiversity based on key functional groups of fauna and microflora.

***Expected Output 1.4. Scientists at each target site trained in appropriate and standard methods for full implementation of ASB research.***

*Results*

Training within the benchmark sites has emphasised the incorporation of environmental concerns into forest margin agricultural research. On-site training in carbon flux measurement was provided to all benchmark sites during 1994 with follow up visits in 1995. A workshop on greenhouse gas methods was conducted in Indonesia, and one on limiting nutrient trials was held in the Cameroon during 1995. Workshops on below-ground biodiversity were conducted in Peru (August 1995) and Indonesia (December 1995).

**B. Determinants of deforestation and land-use patterns.**

***Expected Output 2.1. Interactive database and information system for each target zone.***

*Results*

The ICRAF GIS Laboratory has undertaken the compilation and synthesis of spatially referenced data relevant to ASB. To date 37 data sets have been obtained from or about the Brazilian, Cameroonian and Indonesian benchmark sites. Of these data sets 11 relate to climate and land use change. These data sets are being integrated through a Data Exploration Tool (DET) written in Arc/INFO which allow for site and zonal analyses. The DET is currently being compiled on CD for dissemination. Licensed Arc/INFO software has been installed and applications of assembled data demonstrated in Brazil and Indonesia. Remotely sensed data (concerning the benchmark sites in Brazil, Indonesia, the Cameroon and Peru) which have a much higher level of resolution are being integrated within the GIS and used to produce detailed maps of rates of deforestation, land degradation and other land use changes at the sites.

***Expected Output 2.2. Prototype models of the determinants of deforestation and environmental degradation.***

*Results*

Models have been developed for the Brazilian and Indonesian benchmark sites which reveal interesting differences in the dynamics of the two areas. The Brazilian model (Fujisaka, 1995) relates deforestation rates to land speculation for new pasture establishment, degradation rates of current pastures, need for 'newly cleared lands' for food crop production and the policies and technical options which promote perennial crops. The Indonesian model (van Noordwijk et al. 1995) depicts separate environmental consequences (biodiversity loss, GHG emissions and watershed stability) being driven by natural resource management strategies employed by smallholders, large enterprises and government projects. A key component to this model is the division of land use between food crops (annuals) and cash crops (perennials) by increasing populations and migrants.

## C. Preliminary assessment of agricultural productivity and environmental impact of selected land-use systems.

***Expected Output 3.1. Identification of key constraints to agricultural production, environmental quality and sustainable land use.***

*Results*

Forest clearing by slash-and-burn farmers was shown to be driven by poverty, food insecurity and unsustainable cropping practices. These constraints have been detailed and analysed in a report produced by WRI which synthesises baseline information on the political economy of shifting cultivation and slash and burn agriculture.

***Expected Output 3.2. Identification of priority policy constraints for sustainable land use systems.***

*Results*

Analysis of the current policy environments in benchmark countries confirmed that principal policy constraints include (i) colonisation and road building policies (Brazil, Indonesia); (ii) tax and credit policies favouring land clearing (Brazil); (iii) resource tenure policies (all countries); (iv) negative international terms of trade in humid forest zones and fluctuations in international market prices for principal agricultural commodities, timber and non-timber tree products (all countries); and (v) lack of involvement of local communities in management of their natural resources (all countries).

***Expected Output 3.3. Initial estimates of carbon balance in three sites.***

*Results*

The carbon stocks and fluxes associated with different land uses were measured by national scientists at the three benchmark using standardised field methods. This contrasts with the common approach in global carbon inventories of using assumptions or remotely sensed or model-generated estimates for relatively inaccessible components such as understorey or soil carbon. To date the carbon pools have been measured at 61 field sites and in nine different land uses (primary forest, logged-over forest, secondary forest, fallows, cropland, pastures, plantations, multi-strata agroforests and abandoned lands). Carbon accumulation during fallow recovery was quantified permitting prediction of the carbon sequestration changes accompanying increased land use pressure and reduced fallow intervals. Measurement of the separate carbon pools and their relative stability under land use pressure will assist in determining strategies for carbon management during land conversion.

The carbon flux measurements can be extrapolated in two different ways. Land use inventories are available for the benchmark sites with classes that correspond to the land uses in which carbon was measured. Simple accounting procedures can thus derive an estimate of total carbon stocks for a given inventory entry. As already mentioned, spatial distribution of different land uses has been measured by remote sensing and incorporated into a GIS. The maps thus produced include land uses in which carbon stocks were measured and permit extrapolation of the results in a relatively rigorous way. Approaches of this kind have been identified by IPCC as essential for the development of accurate carbon balances.

Some initial examples of land use changes with global incremental benefits in terms of carbon sequestration which are in addition technically feasible and economically viable from the farmers' perspective have been identified. In Cameroon, where a disproportionate amount of biomass carbon is contained in the few largest trees, improved land conversion methods would conserve 25%-40% of the live tree biomass carbon that is otherwise lost to the atmosphere (approximately 75 t $ha^{-1}$). In Rondonia, Brazil, farmers have the opportunity to transplant indigenous timber and fruit tree species into the recovering pasture fallows. Such silvopastoral systems can sequester 125 t C $ha^{-1}$ in tree biomass within twenty years.

***Expected Output 3.4. Test of models for initial predictions of carbon storage/loss for three sites.***

*Results*

Data from the benchmark sites were used as input files for the CENTURY Ecosystem Carbon Simulation Model and used to explore the effects of alternative land management strategies on carbon dynamics over varying time periods. Examples of model outputs include defining system carbon storage as fallow interval declines (Indonesia), steady-state carbon levels under different pasture management regimes (Brazil) and soil carbon in croplands with and without organic input and erosion control regimes (Cameroon).

**Additional results.**

The GEF-funded research in Phase I yielded results beyond those definable in terms of the contracted outputs. A particularly interesting outcome derived from the work in Indonesia. The national Government there has two fundamental but mutually inconsistent laws on forest land use that create a legal basis for overlapping claims over forest land. This has led to conflicts between the customary claims of local people and the 'rights' of forest production interests. This legal ambiguity has caused insecurity for smallholders and large-scale operators alike and is undermining incentives for sustainable resource management.

During Phase I, the ASB Consortium held a workshop on people's participation in degraded imperata grasslands in Indonesia. This was followed by a series of discussions between the Department of Forestry and ASB partners, at the request of the Department of Forestry. As a consequence the Minister of Forestry has requested ASB to advise and support his department in the framing of an appropriate institutional, regulatory and policy reform for removing the current contradictions in the legislation. Implementation of this reform should lead to decreased land degradation and increased biodiversity conservation by smallholders and therefore to global environmental benefits.

Greenhouse gas emissions: The primary activity during Phase I was developing and testing methods for sampling and transporting gas samples in remote locations so that a standardized method could be used at all sites. Results showed that some land-use practices can indeed maintain the $CH_4$ sink that is characteristic of natural forest systems while others diminish that sink and may even be a net source of $CH_4$. Preliminary results for nitrous oxide emissions show higher emissions from forests than agricultural systems.

ANNEX C:

## ASB Publications for Phase I


Avila M. 1994. *Report of research-site selection in Acre and Rondonia states of Amazon Region Brazil. 31 August–15 September 1992.* Nairobi: ICRAF.

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Baxter J. and van Houten H. (eds). 1994. *Alternatives to Slash-and-Burn: A global initiative.* Nairobi: ICRAF

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Palm C., Izac A.M. and Vosti S. 1995. *Procedural guidelines for characterization.* Nairobi: ICRAF.

Sanchez P.A. and van Houten H. (eds). 1994. *Alternatives to slash-and-burn agriculture. Symposium 1D-6, 15th World Congress of Soil Science, Acapulco, Mexico, 10–16 July 1994.* Co-published by the International Society of Soil Science, Chapingo, Mexico and ICRAF. Nairobi: ICRAF

Swift M.J. and Bandy D.E. 1995. *Project management by consortium.* ICRAF: Nairobi.

Van Noordwijk M., Tomich T.P, Winahyu R., Murdiyarso D., Suyanto, Partoharjono S and Fagi A.M. (eds). 1995. *Alternatives to Slash-and-Burn in Indonesia. Summary report of Phase I.* Nairobi: ICRAF.