# TROPICAL FORESTS

## A State of the Art at the Turn of the Century

Guest Editor : Morgan De Dapper

Koninklijke Academie voor Overzeese Wetenschappen


Academie Royale des Sciences d'Outre-Mer

2004

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# EDITORIAL

The state of the art of the tropical forests is a matter of strong debate.

Lester Brown, speaking for "The Worldwatch Institute", wrote in the *State of the World 2000*, under the heading "Tropical Rainforests : the Inferno beneath the Canopy" : "Eight thousand years ago, before people began to clear land on a broad scale, more than 6 billion hectares, or around 40 percent of the planet's land surface, were covered with forest. Today, Earth's tattered cloak of natural forests (as opposed to tree plantations) amounts to 3.6 billion hectares at most. Every year, at least another 14 million hectares are lost — and maybe considerably more than that. This is an enormous evolutionary tragedy. Among the many thousands of species that are believed to go extinct every year, the overwhelming majority are forest creatures, primarily tropical insects, who have been denied their habitat. That, anyway, is the best estimate, but the forests are vanishing far more rapidly than they can be studied. We really don't even know what we are losing. Currently, well over 90 percent of forest loss is occurring in the tropics — on a scale so vast that it might appear to have exceeded its capacity to surprise us. In 1997 and 1998, fires set to clear land in Amazonia claimed more than 5.2 million hectares of Brazilian forest, bush and savanna — an area nearly 1.5 times the size of Taiwan. In Indonesia, some 2 million hectares of forest were torched during 1997 and 1998" (Brown *et al.* 2000, pp. 24-26).

The Danish statistician Bjørn Lomborg takes a position on the other extremity of the opinion spectrum. He claimed, in his controversial book *The Skepital Environmentalist. Measuring the Real State of the World*, under the title "Forests – are we losing them ?" : "The forests are another form of renewable resource we may be overexploiting. Many people have a strong feeling that the forests are simply disappearing." (p. 110) ... "Globally, forest cover has remained remarkably stable over the second half of the twentieth century. With the longest data series, global forest cover increased from 30.04 percent of the global land area in 1950 to 30.89 percent in 1994, or an increase of 0.85 percentage points over 44 year." (p. 111) ... "it is necessary to look at how much tropical forest has actually disappeared. Although precise figures are not available, the

Conservation Union World, the IUCN, estimates that 80 percent of the original forest cover is still in place. Within historical times, then, just about 20 percent of all tropical forests has disappeared. Compared with the developed world, where we have cleared almost half of our forests, this is a relatively small figure." (p. 114) ... "Tropical forests are being deforested, though on levels much below the feared 1.5-4.6 percent per year — the newest data from the FAO indicate an annual rate of 0.46 percent." (p. 117) (LOMBORG 2001).

However, no matter how divergent the opinions are, two points are at issue :

— The public concern for the fate of the tropical forests which was so vivid in the early eighties of the last century has considerably weakened;
— Most of the tropical forest realm is situated in developing countries which are in the focus of our Academy of Overseas Sciences.

For that reason the "Environment and Development" Commission organized a common session of the three Sections of the Academy on 23 April 2002 in which — along the lines of the broad scope of interest of our Academy — topics from the social as well as from the natural and technical sciences were treated and furthermore three workshops, each highlighting different aspects of the state of the art of the tropical forests :

— Monitoring the Evolution of the Tropical Forest Area (27 May 2002) ;
— Sustainable Management of the Tropical Forest (17 September 2002) ;
— Tropical Forest and Industrial Society (19 March 2003).

The papers and reports of the discussions are presented in this volume.

Morgan DE DAPPER
President Environment & Development Commission
Member of the Academy

## REFERENCES

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Joint Meeting

# Tropical Forests

(23 April, 2002)

*Tropical Forests.*
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# Forêts des tropiques, forêts anthropiques

par

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## Introduction

Emblématique de la mobilisation en faveur de l'environnement, le combat mené pour sauvegarder les forêts des tropiques suscite beaucoup d'efforts et d'intérêt. Symptomatiquement, les plus grands magazines y consacrent leur couverture. Les forêts tropicales sont généralement perçues comme le milieu sauvage par excellence, normalement vide d'humains. Le terme «sauvage» vient d'ailleurs de la sylve, la forêt.

Cette impression est fausse.

Les forêts des tropiques ne sont vierges que dans les fantasmes des citadins occidentaux. Ces forêts sont habitées depuis des millénaires et cela a contribué de façon significative à leur richesse du point de vue de la biodiversité.

Les hommes et les femmes font partie intégrante des écosystèmes forestiers. Ils doivent donc être impliqués dans la conception et la mise en œuvre des projets de conservation et de développement. Les échecs que l'on connaît en matière de préservation des écosystèmes tropicaux s'expliquent souvent par une méconnaissance du facteur humain.

Réciproquement, une meilleure information permet aux populations de réfléchir en connaissance de cause sur leur avenir et de devenir ainsi des partenaires dans la définition de stratégies qui les concernent en premier chef.

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Connaissant bien ces peuples pour avoir souvent vécu parmi eux, nous étions persuadés de l'importance du facteur humain dans les actions en faveur de la sauvegarde des forêts et avons lancé en 1994, dans les pays ACP concernés, un vaste programme intitulé «Avenir des Peuples des Forêts Tropicales (APFT)» financé par la Commission Européenne grâce à la ligne budgétaire consacrée aux forêts tropicales.

Nous croyons utile, dans la réflexion que lance l'Académie, de vous présenter les résultats, constatations et recommandations de ce programme APFT, qui s'est achevé il y a un peu plus d'un an.

APFT était un consortium d'institutions publiques européennes. Piloté par l'ULB, il regroupait aussi, en Belgique, la Faculté Universitaire des Sciences Agronomiques de Gembloux, en France, l'IRD (ex-ORSTOM) et le CNRS, et au Royaume-Uni, l'Université de Kent, ainsi que de très nombreuses autres équipes dans les pays ACP : au Cameroun, Gabon, R. D. Congo, Guyane, Guyana, Papouasie-Nouvelle-Guinée, Vanuatu, soit plus d'une trentaine de chercheurs européens et ACP, dont beaucoup viennent de passer plusieurs années parmi les populations.

APFT a visé à la fois un travail comparatif à partir de données recueillies sur divers continents et un travail interdisciplinaire. Etaient ainsi associés autour des anthropologues différents spécialistes de sciences humaines et naturelles.

Dans un contexte dominant de préservation des forêts tropicales, notre démarche a été, non de nous faire les avocats délibérés des hommes, mais plutôt de réfléchir sur deux postulats simples :

— Une saine gestion de l'environnement tropical ne peut se faire sans un épanouissement des êtres humains qui y vivent et en vivent ;
— La persistance de milieux riches en biodiversité prouve l'ancienneté de pratiques humaines et son impact positif sur la continuité de ces milieux.

Les observations scientifiques accumulées au cours du siècle qui vient de s'achever montrent que l'homme est capable de gérer convenablement son milieu, pourvu qu'il dispose de bonnes conditions sociales, politiques et économiques.

Nos observations nous apprennent également que les savoirs, les savoir-faire, et plus modestement les pratiques quotidiennes que nous décrivons dans notre rapport, font partie d'un patrimoine précieux pour l'humanité entière.

Ces constatations nous amènent à souligner l'opposition flagrante qui existe entre deux concepts :

— Celui du développement qui est orienté en principe vers le bien-être des hommes mais dans une perspective immédiate. Il répond parfaitement aux critères de rapidité de notre monde contemporain.
— Celui du développement durable qui, au contraire, introduit la notion de durée et de reproduction à long terme.

Notre position s'est, d'entrée de jeu, portée sur l'option d'un développement durable. Elle est dictée par des réalités simples :

— La protection de l'environnement connaît depuis trente ans une succession d'échecs criants.
— Le développement «classique» est trop rarement parvenu à accroître le bien-être de la majorité des peuples du Sud ; partout la pauvreté a progressé avec son cortège de crises sociales, politiques ou humanitaires.

A partir de ce choix, le programme APFT s'est efforcé de rendre compte de la réalité des pays soumis à la fois aux politiques de développement et à la protection de l'environnement.

Un dispositif de vingt-trois sites de terrain dans neuf pays de la zone ACP nous a permis de recueillir des informations précises, pluridisciplinaires et comparatives. La comparaison des modes de vie et des situations en Afrique centrale, en Amazonie et en Mélanésie, met en évidence les points communs que la connaissance du contexte local permet de dégager. Penchons-nous globalement d'abord sur la situation des forêts tropicales en général, puis sur chacun des continents étudiés.

Malgré les efforts déployés par la communauté internationale, les forêts tropicales qui concentrent une part très importante de la biodiversité mondiale continuent de disparaître à un rythme effrayant. La grande forêt a déjà quasiment disparu d'Asie, d'Amérique centrale et d'Afrique de l'Ouest.

Il reste deux grands massifs forestiers, véritables poumons verts de notre planète, les bassins de l'Amazone et du Congo. Tous les indicateurs à notre disposition montrent qu'ils sont aussi gravement menacés.

## L'Afrique centrale

De l'Amazone et du Congo, c'est ce dernier massif qui proportionnellement est le plus menacé. En effet, si les surfaces déboisées

annuellement sont plus importantes en Amérique du Sud, ce massif étant plus grand, la proportion défrichée annuellement y est plus faible que dans le bassin du Congo.

L'analyse des données satellitaires ne laisse pas d'être extrêmement préoccupante. Au Cameroun, en Centrafrique, en Guinée-Equatoriale, au Gabon, dans les deux Congo, la forêt est de plus en plus morcelée, exploitée, malgré tous les efforts. Il faut bien constater que les crises militaro-politiques qui affectent plusieurs des pays de la région s'avèrent jusqu'à présent parfois plus efficaces en matière de conservation, en tous les cas face à l'exploitation forestière. Ce n'est pas le moindre paradoxe de la situation.

L'échelle d'exploitation des forêts a été complètement modifiée suite à l'arrivée des entreprises asiatiques. La transformation sur place du bois, qui augmente la part des revenus dévolus aux Etats et est donc un facteur positif, accroît parallèlement les risques écologiques en multipliant le nombre d'essences exploitées.

Malgré tous les efforts réalisés, l'exploitation forestière ne profite guère aux populations elles-mêmes qui devraient pourtant être considérées comme des acteurs privilégiés. Les exploitants forestiers l'ont bien compris. Ils ne se privent pas de séduire les habitants de la forêt, se substituant à bon compte à l'Etat défaillant en entretenant les pistes, en construisant les écoles et les équipements sportifs,...

Le secteur informel constitue le rouage le plus dynamique du fonctionnement de l'économie africaine. Dans le cadre plus particulier de notre étude, il est le seul lien solide entre les communautés forestières et la ville. Les économies de subsistance restent les seules capables de sustenter les populations, de ville comme de brousse. Dans ces économies extrêmement opportunistes, l'agriculture pèse d'un poids accru face à la dégradation des forêts, mais la chasse, la pêche et la cueillette fournissent encore la majorité des protéines.

L'enjeu majeur pour une exploitation viable — et donc durable — de l'espace forestier passe par la formation. La carence en cadres, en responsables et en techniciens qualifiés, opérant réellement sur le terrain, est criante. Pire encore, alors que la transmission des savoirs traditionnels connaît un hiatus, on assiste à une régression de l'alphabétisation.

S'il est économiquement impensable de priver l'Afrique de l'exploitation de ses ressources naturelles, il faut que l'exploitation de la forêt soit raisonnable et raisonnée. Seule une meilleure structuration de l'Etat, améliorant sa capacité d'intervention et mettant en question ses points faibles, permettra de relever ce défi. La conservation des forêts passe

aussi par la bonne gouvernance. De même la résorption de la pauvreté conditionne le succès des politiques de conservation.

## L'Amazonie

En Amazonie, nous avons principalement travaillé sur les Guyanes. Nos constatations peuvent se résumer comme suit :

— Toutes les communautés sont aujourd'hui affectées par le système politico-administratif de l'Etat dont elles dépendent, et en particulier par l'électoralisme ;
— L'engagement dans le système monétaire global affecte la plus grande partie de ces communautés ;
— Les infrastructures sont partout mal gérées, en mauvais état, et souvent ruinées, par manque d'employés et de cadres locaux ;
— La mécanisation des exploitations forestières et minières a fortement augmenté la pression sur les ressources naturelles.

Quelques éléments positifs sont toutefois encourageants :

— L'essentiel des calories des communautés forestières reste fourni par l'agriculture sur brûlis, et les activités de subsistance non seulement conservent une place centrale dans l'alimentation, mais ponctuent encore le quotidien des habitants ;
— Tout ce qui constitue le sel de la vie perdure : les systèmes de parenté, les valeurs philosophiques, les rythmes quotidiens de la vie sociale,...

Quatre préalables fondamentaux devraient pouvoir contribuer à l'épanouissement de ces sociétés :

— Les populations devraient bénéficier d'un droit de propriété collective de la terre.
— Un peuplement harmonieux peut être maintenu par le respect de la dispersion de l'habitat.
— Une liberté d'initiative que les administrations doivent encourager en favorisant l'émergence de leaders locaux, traditionalistes ou modernistes.
— Il faut contribuer à un renforcement de la conscience de soi. Ceci ne peut se faire que par un développement lent qui mette l'accent sur des

infrastructures de base modestes générées localement et le développement d'une éducation adaptée.

## La Mélanésie

Les Mélanésiens comptent parmi les agriculteurs les plus raffinés du monde. Nous sommes ici dans une des régions où l'homme, en domestiquant très tôt nombre de plantes, a été lui-même massivement créateur de biodiversité. Il n'est pas exclu que ce soit ici que l'on ait même inventé la domestication des plantes des millénaires avant le croissant fertile.

En Mélanésie nous avons pu constater que :

— D'une part, les valeurs morales traditionnelles restent fortes et les élites sont profondément guidées par ces valeurs ;
— D'autre part, les jeunes Etats, en laissant les communautés totalement maîtresses de leur territoire, les livrent à la spéculation capitaliste en l'absence de tout mécanisme de rééquilibrage.

Le pari de la Mélanésie est donc de trouver rapidement un équilibre entre des valeurs traditionnelles officiellement valorisées et un Etat-nation réellement vécu par tous.

Après ces quelques considérations au niveau continental, ce survol des trois continents où nous avons travaillé, nous voudrions aborder, de façon plus pointue, certaines questions qui nous paraissent essentielles dans le cadre des programmes de développement durable.

Connaître ce qui existe avant de le changer nous a semblé une démarche stratégique de la plus haute importance.

Il importe aussi de dénoncer nombre de fausses vérités, de lieux communs qui déforment la réalité et désorientent les projets.

L'efficacité de l'action en faveur du développement et de l'environnement des populations sylvicoles passe par quelques mises au point propres à redonner aux décideurs une image plus nette des lieux, des hommes et des enjeux.

Il s'agit bien ici de mettre en avant le rôle même de l'anthropologue. Par son travail sur le terrain :

— Il apporte des données techniques nécessaires à la réalisation pratique d'un programme ;
— Il informe sur les connaissances fondamentales et objectives propres aux populations concernées ;

— Il transmet aux décideurs et entrepreneurs les préoccupations de sa communauté d'accueil ;
— Réciproquement, il informe la communauté d'accueil de la réalité du monde extérieur, qu'elle ignore ou méjuge souvent.

## Questions

Les questions que nous allons aborder n'ont pas un caractère prioritaire ou exclusif. Elles présentent la particularité d'être complémentaires et interactives. Ainsi on ne peut parler de démographie sans parler d'alimentation, et l'exploitation forestière ne peut être évoquée sans parler des routes, mais aussi de l'argent et du pouvoir.

Il s'agit donc d'un véritable puzzle dont nous voulons mettre certaines pièces en évidence, sachant que les unes comme les autres font partie d'un tout.

Nous avons, dans notre rapport, retenu trente-six questions. C'est sur certaines d'entre elles que nous voudrions attirer plus particulièrement votre attention.

Notre objectif est d'améliorer la stratégie et les actions de l'Europe en faveur des forêts tropicales et de leurs habitants. Quand on sait que plus de 60 % des moyens consacrés dans le monde à la préservation de celles-ci proviennent d'Europe, on comprend l'importance de l'enjeu.

### Les préjuges et les modes influencent-ils les politiques de developpement ?

Les stéréotypes et les lieux communs orientent le regard de l'Occident sur les peuples des forêts tropicales. Or de faux préjugés de départ conduisent nécessairement à de mauvaises politiques.

L'attitude générale est faite de incompréhension. On compare toujours de manière défavorable les techniques et les valeurs des communautés forestières avec celles de la société dominante ou celles des pays du Nord :

| | par opposition | |
|---|---|---|
| — Agriculture itinérante | | — Agriculture permanente |
| — Mobilité saisonnière | | — Sédentarité |
| — Habitat dispersé | | — Regroupement en village |
| — Diversité linguistique | | — Pouvoir unificateur d'une langue nationale |

Cette méconnaissance des réalités locales a entraîné échecs et dérives.

*Recommandations*

— Ne pas appliquer de projets modèles ;
— Partir des réalités de terrain ;
— Tenir compte des besoins locaux.

### Qui sont les peuples des forets tropicales ?

A ne prendre en considération que quelques populations mythiques (tels les Pygmées ou les Yanomami), on court le risque :

— De provoquer jalousie et ressentiment ;
— De spolier toutes les autres, bien plus nombreuses.

Les forêts denses humides sont habitées depuis plusieurs milliers d'années : il n'y a pas de forêt vierge.

Plusieurs couches de peuplement se sont succédé, dont les avant-dernières sont liées à l'histoire coloniale et les dernières au développement moderne. Il en résulte un peuplement complexe, diversement mélangé.

Dans les pays ACP, plus de quatre millions de personnes vivent dans les forêts. Ces peuples représentent une mosaïque de près de mille langues, groupes, attitudes, histoires différentes, ainsi que des relations intercommunautaires variées.

*Recommandations*

— Recenser les diverses communautés en présence, leurs langues et leur histoire avant tout projet ;
— Adapter les projets aux diversités culturelles locales ;
— Prendre en compte les attitudes des populations voisines les unes envers les autres, et anticiper sur des attitudes de méfiance ou de rejet ;
— Ne pas concentrer les actions de développement sur une poignée de groupes forestiers au détriment des autres, car c'est prendre le risque de dresser contre ces groupes des populations écartées.

LES PEUPLES DES FORETS TROPICALES SONT-ILS EN VOIE D'EXTINCTION ?

Les peuples forestiers ne s'éteignent plus. Depuis une quarantaine d'années, la démographie s'accroît sensiblement : près de la moitié de la population a moins de quinze ans. Cependant, la mortalité avant l'âge de cinq ans reste importante.

L'âge des filles au mariage reste jeune. Une femme peut être grand-mère à trente ans, tout en ayant elle-même des enfants en bas âge.

La migration vers les villes compense le solde naturel positif, surtout en Afrique. De tels mouvements modifient profondément la composition de la population car ce sont majoritairement les jeunes adultes qui migrent.

*Recommandations*

— Ne pas s'appuyer sur les recensements officiels car ils sont peu fiables ;
— Améliorer la couverture médicale et surtout développer la protection maternelle et infantile ;
— Faire admettre aux Etats l'importance du contrôle des naissances pour le développement durable.

SI LA CROISSANCE DEMOGRAPHIQUE EST PARTOUT SENSIBLE, NE RISQUE-T-ELLE PAS A SON TOUR DE PERTURBER LA DISPONIBILITE EN RESSOURCES ?

Compte tenu des évidences archéologiques et historiques, on peut considérer que la forêt équatoriale est capable de supporter une densité de population plus grande qu'actuellement.

Les groupes forestiers constituent le plus souvent de petites communautés dispersées en hameaux sur de vastes territoires. La densité de population est actuellement faible partout. L'impact sur la biodiversité est en conséquence très diffus.

C'est à la suite de la définition de plans de zonage trop étroits qu'on observe systématiquement une moindre rotation des cultures, un raccourcissement des jachères, une surexploitation de la forêt par la chasse et la collecte. Les regroupements de villages dispersés, les déplacements forcés et la fixation des habitats mobiles, trop rapides, ont également pour résultat d'accroître la pression sur les ressources. Comme nous le verrons plus loin, importance du territoire, mobilité, dispersion et diversité des ressources sont étroitement liées.

La plus grande pression sur les ressources forestières est provoquée d'abord par l'expansion des villes au détriment des campagnes.

Puisque nous utilisons le terme de campagne, c'est le moment d'évoquer l'agriculture sur brûlis avec tout son cortège d'incompréhensions et de critiques qui en résultent.

### Qu'est-ce que l'agriculture sur brulis ? Est-elle reellement une cause de deforestation ?

Il convient tout d'abord de ne pas confondre «agriculture sur brûlis» et «défrichement par le feu» :

— L'agriculture sur brûlis traditionnelle est itinérante et donc temporaire ; elle n'entraîne donc pas de déforestation à terme.
— Le défrichement par le feu très largement pratiqué par des colons ou des éleveurs à la recherche de nouvelles terres est destiné à une occupation permanente. Il entraîne une perte de surfaces forestières.

Le système de l'agriculture sur brûlis est un cycle complexe bâti sur une courte période d'exploitation du sol, suivie d'une très longue phase de jachère. Il suppose donc une itinérance qui seule garantit la fertilité et la productivité.

*Recommandations*

— Avant de fixer l'agriculture forestière, il faut avoir résolu le problème de la reconstitution des sols ;
— Les plans de zonage et d'aménagement doivent intégrer la notion de jachères longues et pas seulement celle d'exploitation vive des terres.

Les questions qui se posent alors sont :

### Les ressources sauvages sont-elles un luxe ou une necessite ?
### Pourquoi est-il besoin de tant d'espace ?
### *In fine*, les populations forestieres menacent-elles la biodiversite ?

Si l'agriculture donne la part quantitative du régime alimentaire, c'est la forêt qui en fournit la part qualitative. C'est ce qu'on appelle les ressources sauvages, résultant de trois activités complémentaires : la

chasse, la pêche et la collecte. Mais la forêt procure aussi à ses habitants une grande diversité de matériaux et de produits nécessaires à leur vie quotidienne (constructions, outils, vannerie, instruments de musique, plantes médicinales,...).

La dispersion de ces ressources et leur diversité impliquent que ces activités traditionnelles de prédation se pratiquent sur des surfaces de forêt considérablement plus importantes que les activités agricoles. Mais c'est précisément la grande dimension des territoires sur lesquels celles-ci sont pratiquées qui allège la pression en un point donné et favorise une exploitation souple et extensive.

Or le nomadisme ou la mobilité sont encore trop souvent perçus comme un facteur de sauvagerie, alors qu'ils font partie du système économique flexible partout mis au point par les populations forestières.

Nous avons pu constater que lorsqu'on laisse aux populations locales les moyens de pratiquer leur genre de vie, elles ne sont pas destructrices de leur milieu.

Les pratiques agricoles elles-mêmes peuvent aboutir à la création des forêts anthropiques, entièrement constituées d'espèces utiles.

Les déséquilibres et l'accroissement des prélèvements sont en fait toujours provoqués par la demande externe.

*Recommandations*

Des réglementations, même réalistes, n'ont de chance d'aboutir que si sont pris en compte :

— D'un côté, les économies de subsistance des communautés humaines ;
— De l'autre, les capacités naturelles de reconstitution de la faune et de la flore.

Penchons-nous maintenant sur deux questionnements d'importance dans le cadre d'un projet : le rôle de la femme dans la communauté et les éléments du pouvoir.

QUELLES EST LA PLACE DONNEE AUX FEMMES DANS LES ECONOMIES FORESTIERES TRADITIONNELLES ?

Jusque tout récemment, on constatait dans les sociétés forestières une forte division sexuelle du travail basée sur une complémentarité des tâches.

Cette situation s'est profondément altérée depuis une trentaine d'années. On constate l'aggravation de l'inégalité entre hommes et femmes qui est, paradoxalement, une conséquence de la modernité. En effet :

— Un premier déséquilibre résulte de l'introduction des cultures de rente monopolisées par les hommes tant pour les travaux que pour la vente et les revenus induits ;
— Un second déséquilibre résulte de l'intrusion du système monétaire dont les hommes sont devenus maîtres.

Les femmes et filles, restant dans les communautés, voient s'accroître le poids des tâches leur incombant.

*Recommandations*

Il faut veiller à :

— Garantir aux femmes des revenus monétaires en favorisant la vente des produits vivriers ;
— Chercher à développer l'alphabétisation pour les femmes non scolarisées tout en étant vigilants sur la présence des fillettes à l'école.

Dans un projet de développement, il est fondamental de savoir à qui s'adresser. Il est donc nécessaire de savoir qui détient le pouvoir chez les peuples des forêts tropicales. C'est l'objet de notre question suivante.

## Qui detient le pouvoir chez les peuples des forets tropicales ?

Un pouvoir le plus souvent diffus et peu marqué a souvent nui au dialogue avec l'extérieur.

Nous sommes de fait en présence de sociétés à fort nivellement social. Les décisions sont consensuelles et le chef voit son pouvoir borné à sa capacité à fédérer les siens.

Aujourd'hui, la chefferie traditionnelle et les rouages sociaux permettant les prises de décision sont en crise, contestés par la jeunesse scolarisée. Celle-ci fournit de nouveaux médiateurs, de qualité très variable.

*Recommandations*

— En tout état de cause, déterminer quels interlocuteurs le planificateur trouve face à lui ;

— S'adresser à des individus en encourageant les projets individuels viables ;
— Aider à la formation civique des jeunes et des nouveaux médiateurs.

Et nous en arrivons ainsi à pouvoir aborder les questions résultant de la modernité.

### Quelles perturbations les populations doivent-elles affronter ? Comment reagissent-elles au changement ?

Les pressions que subit la forêt se reportent sur les populations qui y habitent. Un projet de développement mal conçu peut être ressenti comme une perturbation catastrophique.

Quelles stratégies sont développées en dehors de tout projet de développement ? Les changements proposés (imposés) par l'extérieur correspondent-ils aux besoins réels des populations ?

La recherche des produits d'exploitation comporte des risques pour l'environnement comme pour les populations locales :

— Exploitations forestières et minières : perturbent les équilibres écologiques, polluent les cours d'eau, entraînent le déclin des ressources vitales (gibier, poisson, matériaux, terres agricoles,...) et provoquent l'intrusion de populations allogènes dont l'ouverture de routes favorise la pénétration ;
— Agriculture industrielle, élevage intensif, colonisation paysanne : sont accompagnés de spoliation des terres, de déboisement, d'intrusions qui entraînent des surexploitations (chasse, pêche).

Même l'implantation d'une aire protégée comporte des risques car elle peut conduire à l'éviction des habitants ou tout au moins à une limitation importante de leurs activités.

Les perturbations qui accompagnent le changement en multiplient le coût :

— Perte des territoires ancestraux : sentiment de déracinement ;
— Marginalisation économique : sentiment de pauvreté ;
— Augmentation des conflits de générations : désordres sociaux.

Néanmoins, toutes les communautés forestières aspirent au confort et aux biens véhiculés par la civilisation occidentale. L'outillage moderne

est apprécié car il facilite le travail. Il faut souligner que son usage n'entraîne pas automatiquement une surexploitation du milieu s'il n'y a pas de sollicitations extérieures.

*Recommandations*

— Concevoir des plans d'aménagement à l'échelle régionale prenant en compte les réseaux unissant l'ensemble des populations présentes ;
— Faire respecter très rigoureusement les réglementations des exploitations minières et forestières ;
— Valoriser les savoirs et les techniques traditionnels en les intégrant dans le cycle scolaire, et solliciter la capacité d'innovation endogène dans la conception du projet de développement.

Et puisque nous parlons de cycle scolaire, posons-nous la question de l'école.

## Quelle scolarite, pour quels eleves ?

Une chose est claire et certaine, toutes les communautés souhaitent que leurs enfants aillent à l'école.

Mais copier ne veut pas dire calquer. Or les programmes scolaires, calqués sur ceux du Nord, sont inadaptés tant aux pays du Sud qu'aux populations locales. Les éducateurs eux-mêmes oublient toujours que la langue d'enseignement n'est pas la langue maternelle de leurs élèves, mais une langue étrangère.

De plus, dans de jeunes Nations dont plus de la moitié de la population a moins de quinze ans, les moyens mis par l'Etat dans les infrastructures scolaires sont fatalement insuffisants.

*Recommandations*

— On ne doit pas oublier que l'éducation familiale et tribale reste la seule dispensatrice de l'apprentissage des techniques et de la connaissance du milieu : la pratique scolaire ne doit pas l'entraver.
— Il faut bâtir un enseignement technique et pratique diversifié et adapté aux besoins de la Nation. Pousser les quelques élèves dont on est sûr vers un enseignement élitiste afin qu'ils deviennent médecins, juges d'instruction, ingénieurs,... qui font cruellement défaut au pays.

Deux facteurs résultant directement de la modernité vont avoir un impact important sur la vie des populations. Ils sont sujets à des évaluations contradictoires ; ce sont la route et l'argent.

### La route est-elle la voie du developpement ?

Aux yeux des populations, très souvent oui. La route cristallise l'opposition qui demeure dans les esprits entre :

— La conservation, c'est-à-dire le maintien d'une nature sauvage ;
— Le développement, qui implique le désenclavement des populations forestières.

La route peut favoriser l'écoulement de la production agricole et donc l'intégration des communautés à l'économie régionale, voire nationale et internationale. Mais ceci uniquement si elle provoque une augmentation du trafic des véhicules... et pas seulement des grumiers.

La route peut aussi être une source de destruction de l'environnement et donc d'appauvrissement des populations.

*Recommandations*

Pour faire de la route un élément favorable au progrès, il faut, avant de la créer :

— Recueillir des données précises et quantifiées sur les effets positifs ou négatifs de sa construction ;
— Consulter les populations avant les travaux et respecter leurs desiderata pour le tracé ;
— Verser des compensations équitables en fonction des dégradations prévues ;
— Favoriser les politiques de transports publics sur les routes nouvellement créées ou améliorées et mettre au point, avant leur création, un programme d'entretien de celles-ci.

Si la route peut, à certaines conditions, contribuer au développement, elle est aussi la voie par laquelle va apparaître l'argent.

### L'argent fait-il le progres ?

Est-ce parce qu'un Etat est pauvre qu'il faut aussi considérer que ses habitants vivent dans la pauvreté ? La pauvreté est une notion occidentale

fondée sur l'usage de l'argent et qui est évaluée selon des indicateurs définis dans les pays du Nord ; elle ne peut s'appliquer directement au mode de vie rural.

L'usage de l'argent se développe suite aux contraintes administratives telles que taxes, impôts, frais de scolarité et de santé, et comme résultante du développement des activités coloniales telles que cultures de rente ou collecte de produits forestiers non ligneux. Même si de nombreuses communautés forestières n'utilisent pas encore l'argent, les populations forestières sont de plus en plus impliquées dans l'économie de marché.

Tous les programmes de développement s'appuient sur la logique de l'économie de marché. Tous créent des besoins dans les communautés, que seul l'argent peut satisfaire. Or l'insertion dans l'économie de marché provoque souvent la paupérisation des populations.

Pour faire face à des besoins primaires immédiats (santé, école, etc.), les populations se voient contraintes de vendre les surplus qui leur feront cruellement défaut en période de soudure, ce qui les amène à devenir destructrices de leur environnement par la chasse et la pêche professionnelles et l'extractivisme intensif.

Le développement d'activités de production marchande comporte un double risque :

— Engendrer la compétition entre le gain individuel et les besoins de la communauté ;
— Créer des conflits lors de la distribution des gains collectifs par la faiblesse des structures politiques autochtones et l'absence d'autorité incontestable.

La politique commerciale internationale a des conséquences profondes et brutales pour les communautés forestières qui les subissent sans défense et sans mécanisme régulateur. Elle entraîne pour les villageois de fortes baisses de revenus. La nécessité de revenus monétaires conduit alors les paysans à chercher d'autres produits commercialisables.

*Recommandations*

L'ensemble de ces impacts négatifs ne peut être maîtrisé par les pays du Sud seuls. Il faut une conjonction d'efforts entre le Nord et le Sud :

— D'abord en garantissant aux produits d'exportation un prix minimal stable ;
— Ensuite par la mise en place de réseaux de distribution visant au développement des activités agricoles à l'échelle régionale plutôt qu'à

l'exportation, ce qui implique de donner la priorité aux cultures vivrières plutôt qu'au développement des cultures d'exportation.

Un élément de progrès peut résulter des structures associatives existantes et des systèmes endogènes de micro-crédit.

Les routes et l'argent nous ont entraînés vers les villes, ces réceptacles de la migration et du trop-plein des forêts.

### QUEL EST L'IMPACT DES VILLES SUR LES ECOSYSTEMES FORESTIERS ?

L'accroissement sensible des villes situées en zone forestière entraîne de sérieux problèmes d'approvisionnement. Il s'accompagne d'une urbanisation sauvage dévoreuse d'espace. Là où, comme en Afrique centrale, ville et forêt sont proches l'une de l'autre, la dynamique de croissance urbaine a des effets négatifs sur les efforts de développement et de conservation ruraux.

L'opposition classique «rural contre urbain» s'estompe cependant. La modernité pénètre les villages tandis que les comportements villageois sont fréquents en ville.

Mais les perceptions citadines de la forêt et de sa conservation jouent un rôle important, du fait que les décideurs vivent en ville. On observe fort heureusement la naissance d'une prise de conscience sur la nécessité de la conservation.

#### *Recommandations*

Pour favoriser la conservation, il convient de limiter la dépendance des populations urbaines par rapport aux produits forestiers en planifiant l'approvisionnement des villes.

Pour inciter les décideurs des villes à prendre au sérieux la conservation, il faut d'abord leur fournir des informations fiables et leur donner ensuite les moyens de concevoir des plans de sensibilisation à l'environnement par l'éducation.

### FAUT-IL LAISSER DES HOMMES DANS LES AIRES PROTEGEES ?

Les écosystèmes équatoriaux actuels sont tous anthropiques. Les activités traditionnelles sont parfaitement compatibles avec le maintien d'un couvert forestier et d'une faune diversifiés, et donc peuvent s'accommoder de l'aire protégée. Pourtant, le comportement des

villageois est toujours considéré à tort comme étant responsable des problèmes environnementaux.

*A contrario*, ne craignons pas d'affirmer que ce sont les activités à vocation commerciale qui sont à l'origine des actuelles perturbations de la forêt.

*Recommandations*

Dans les plans de zonage, il faut :

— Tenir compte de toutes les activités humaines ;
— Apprécier le seuil d'exploitation tolérable.

Dans les plans de conservation, il faut :

— Agir à l'échelle de la micro-région ;
— Ce qui sous-entend une prise en compte de la richesse des agroécosystèmes.

Dans le cadre des activités de l'aire protégée, on veillera à valoriser les savoirs locaux sur le milieu et à concevoir des plans de conservation de la biodiversité au niveau régional.

Aires protégées ou développement durable ? Qu'en est-il réellement sur le terrain ?

CONSERVER OU DEVELOPPER ?

Ces deux objectifs sont-ils compatibles ? Les programmes réussissent-ils à les coordonner ?

Comment les communautés locales réagissent-elles à ces efforts ? L'initiative d'un projet de développement ou de conservation leur revient rarement, sinon jamais.

Le facteur temps est d'une importance primordiale : seul le respect de rythmes économiques différenciés débouche sur un développement endogène.

*Recommandations*

— Les utilisateurs doivent aussi être les conservateurs ; il faut planifier la gestion des ressources au niveau communautaire et faire participer les communautés à tous les stades de l'élaboration des plans d'aménagement.

— Former les populations à la logique et aux contraintes de la conservation, mais aussi former les intervenants extérieurs aux mécanismes sociaux des communautés locales.
— Le projet dégageant des revenus, qui sont rarement concrétisés par des aménagements locaux (notamment écoles et dispensaires), on veillera à garantir le retour des revenus générés vers les populations.

## Conclusion

Pour célébrer le dixième anniversaire du Sommet de la Terre à Rio, le bilan en matière de forêts tropicales est pour le moins mitigé. En dépit des efforts consentis, le rythme de leur disparition ne s'est guère ralenti et leurs habitants restent acculés à des situations précaires. Malgré beaucoup de bon vouloir, il ne semble pas y avoir de volonté politique suffisante ni pour prendre les mesures nécessaires et faire passer l'intérêt commun avant celui de quelques-uns, ni pour faire primer les solutions à long terme sur les expédients qui ne résolvent que très temporairement les problèmes.

Il faut cesser de se leurrer et de leurrer les opinions publiques. On ne fait pas tout ce qu'on peut pour préserver les forêts tropicales. Certes les situations sont très diverses et les contraintes souvent énormes, mais il existe aussi de multiples opportunités de faire mieux, plus efficacement.

Bien que cela dépasse le cadre du projet APFT et de nos compétences, il est nécessaire d'affirmer que toutes les propositions doivent être sous-tendues, portées par une véritable volonté politique au sens le plus général et le plus noble, celui du bien commun.

Cette véritable volonté politique est indispensable mais pas suffisante et ce, pour tout un ensemble de raisons :

— Au niveau des stratégies générales, les liens entre le développement durable, la conservation de la biodiversité et la lutte contre la pauvreté sont complexes et leurs objectifs parfois contradictoires.
— Les approches souvent trop compartimentées et les interventions menées sur la base de politiques sectorielles aboutissent, d'une part, à considérer les problèmes de la forêt isolément, d'autre part, à priver de cohérence toute action menée. Cette tendance est encore aggravée par la concurrence entre donneurs et intervenants.
— A propos des forêts tropicales et de leurs habitants, les préjugés, contrevérités et stéréotypes abondent, inspirant inconsciemment les

attitudes et actions en leur faveur. Ils présentent pourtant des dangers majeurs : globaliser notre perception des situations, idéaliser positivement ou négativement le rôle des populations et les caractéristiques de l'environnement, aboutissant à uniformiser les politiques mises en œuvre.

— L'approche est non seulement trop réductrice, elle est aussi trop souvent statique. Or presque toutes les sociétés forestières sont touchées par la modernité et tous les pays concernés, impliqués dans le processus de globalisation. Les changements dont le rythme s'accélère affectent aussi bien les activités que les perceptions et les discours. En matière de politique de conservation des forêts tropicales et de développement durable, les mentalités changent aussi rapidement. En sept ans, une série de concepts a été radicalement révisée. Ainsi de plus en plus nombreux sont ceux qui considèrent que les contraintes majeures en matière de conservation de la biodiversité en général et de gestion des aires protégées en particulier, sont davantage d'ordre social que biologique ou législatif.

Si cette analyse est de plus en plus largement partagée, il faut reconnaître que cela s'est rarement traduit par une réorientation significative des financements en faveur des sciences humaines. Le secteur reste contrôlé par des cadres formés aux sciences naturelles, à l'agronomie et à la foresterie, et donc peu enclins à investir et à s'investir dans des domaines qui leur sont moins familiers.

Sept ans plus tard, le soutien fourni par la Commission Européenne à un programme comme APFT reste donc l'exception.

Quitte à paraître redondants, essayons d'énoncer *quelques grands principes incontournables* qui devraient désormais sous-tendre la politique de l'Union Européenne pour les forêts tropicales :

— Il est indispensable d'allier idéalisme et réalisme si l'on veut ne pas déboucher sur une grave crise au Sud. C'est pourquoi l'Union Européenne doit tenter un équilibre entre une logique d'efficacité et une logique opportuniste. En particulier doivent être définies non seulement quelle exploitation des forêts, mais aussi quelle conservation non économiquement possibles et humainement acceptables.

— Dans leur grande majorité, les habitants des forêts souhaitent le changement, mais ne veulent pas perdre les fondements de leur vie. Encore faut-il qu'ils aient le pouvoir et les moyens de choisir leur développement. Partout où se fait sentir cette volonté de changement,

une aide à la décision doit être mise en place afin que la participation ne se fasse plus dans le sens unique du décideur vers la communauté.

— Parallèlement, le principe de non-intervention ou d'intervention discrète doit être appliqué partout où les communautés vivent bien. Si ce principe de précaution avait été appliqué durant les cinquante dernières années, les avanies d'un modernisme par trop économiste, mal digéré, auraient été épargnées à des millions de personnes. Ceci sous-entend une réévaluation des concepts de pauvreté et de bien-être.
— Dans tous les cas, les décideurs doivent veiller au maintien des économies d'autosubsistance : c'est leur disparition qui est cause de la véritable pauvreté. La viabilité de telles économies repose en priorité sur la garantie de territoires répondant à leurs pratiques. A l'inverse, le modèle consumériste pénètre de façon insidieuse jusqu'au cœur des forêts : en coupant les peuples forestiers de leurs savoirs et en les détournant de leurs pratiques, il est le vecteur majeur d'une pauvreté irréversible.
— En vérité, les communautés forestières n'ont pas une connaissance innée de la nature. La finesse de leurs connaissances et de leur adaptation est une construction éminemment culturelle qu'il convient de respecter, voire d'encourager.
— La protection de l'environnement ne peut se réaliser que si elle s'inscrit dans une politique de plans d'aménagement à l'échelle des Etats concernés. L'illusion est grande de penser que ces plans d'aménagement puissent être élaborés uniquement grâce au support de technologies de pointe telles que les couvertures satellitaires. Seules des enquêtes de terrain permettent de rendre compte de la diversité des situations et évitent les généralisations hâtives, porteuses d'échec.
— La réorientation des stratégies de développement est devenue indispensable.

Elle passe notamment par :

— La définition des projets à partir des besoins réels des communautés ;
— Le financement de la formation d'experts compétents tant du Nord que du Sud.
— Il convient d'adopter une politique humaniste et volontariste à l'égard des hommes des forêts tropicales. L'Europe peut, en partenariat étroit avec les pays concernés, jouer un rôle décisif en faveur des forêts tropicales et de leurs habitants. La Belgique a eu longtemps une des meilleures expertises dans ce domaine. Les recherches menées à

l'IRSAC y font encore référence. Malheureusement, cette expertise n'a pas été entretenue, alors que dans les pays voisins où elle n'était au départ pas comparable, elle a pu être systématiquement développée.

Le monde change vite et les six années de l'aventure d'APFT ne nous permettent guère d'être optimistes. Pourtant, nous avons la conviction que le cours de l'histoire peut encore être infléchi pour les peuples des forêts tropicales et qu'il peut leur être garanti bien-être, survie culturelle et ouverture positive sur le vaste monde.

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# Tropical Forests and Deforestation : a Short Review of Issues

by

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## Introduction

The fate of tropical forests remains high on the list of global environmental concerns. Deforestation continues unabated and, even if decadal rates are fluctuating, the long-term prospects for the conservation of that biome are not bright. The fact that tropical forests are still considered as resources to be exploited for their own commercial value or cut down for the value of the land they occupy does not augur well for any reversal of the current trend. Today, pressures are such that renewable resources are found to be less renewable than expected and it can be argued that, beyond the short-term benefits it may provide, the depletion of forest resources and the reduction of associated ecological services will increasingly affect the local, regional and global human well-being.

While the sometimes dramatic tropical deforestation is unfolding, there is an enhanced realization that, for good or bad, man is also in a position to influence the future course of events. The existence of "inexorable forces of destruction" is not taken for granted anymore and, instead, measures are being set up to reduce the impact of deforestation or, whenever possible, reverse current trends. Sustainable management objectives are now driving many national forestry plans ; the logging industry itself is attempting to adapt its activities to meet the concerns of its environment-conscious customers ; voices are raised in many different sectors of society to find solutions to the degradation of forests throughout the tropics.

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Whether the current awakening will significantly reduce tropical deforestation remains to be seen. However, what has become evident during the last decade is that the burden of any solution to save those ecosystems will have to be shared among stakeholders and interested parties in and outside wood-producing countries. Only a coalition of forces, where every "agent" of deforestation knows its role in the unfolding of the many individual decisions and actions which lead to forest exploitation or conservation, can make a significant difference.

In such context one can take solace in the mechanics of the global market which, while maximizing opportunities for profit, can also reverberate non-commercial preoccupations for social justice and environmental protection. One can thus take comfort from the growing pressure for more transparency in investments in forest operations, for more sustainable management practices in their exploitation and more accountability of stakeholders at various stages of the decision-making process.

Taking stock of the forests' resources, identifying processes leading to their unsustainable exploitation, studying new management practices and unravelling the complex network of pressures and agents which collectively determine their fate is critical in any attempt to propose policy measures. The series of workshops proposed by the Royal Academy of Overseas Sciences is geared to review such knowledge under the overall title "Tropical Forests in a Changing Global Context".

## A Changing Perspective on Forest Resources

In the early eighties the role of forests in the economic development of many tropical countries became the subject of much interest from national governments and international agencies alike. National forestry plans were drafted in that perspective and much aid assistance was devoted to capacity building in forest management and forest industries. Timber trade became the object of international negotiations while many bilateral deals were struck between consumer countries (mainly East Asia) and timber rich countries (South-East Asia and Africa). It is interesting to note that at the same time satellite data were revealing disturbing patterns of deforestation which were by all accounts larger than those usually reported ; the same data also showed an emerging connection between the development of road networks and "bursts" of deforestation. The cases of the Amazon (Rondonia), Central Africa

(Cameroon) and Sumatra were at that time widely reported. Early hypotheses concerning the role of forest in climate change were also raised during that period. The 1992 Rio Conference on Sustainable Development did not include forests in its conclusions leaving room for prolonged and inconclusive discussions in the UN International Forest Forum. The problems of defining sustainable forest management practices were put on the agenda of many research organizations ; the much controversial matter of issuing a certification of such practices started to monopolize the attention of producers and consumers ; fifteen years later it is still hotly debated.

The multifunctionality of forest resources was much underlined during the nineties. The role of tropical forests as habitats and key to the preservation of the earth's biodiversity was central to the International Convention on Biodiversity. The functioning of forests as a carbon source (through deforestation, burning) or sink (through forest growth, reforestation, afforestation) slowly made its way into the Kyoto Protocol ; the inclusion of the biosphere (forests, agriculture, other types of vegetation) in carbon accounting introduced many new opportunities for dealing with the greenhouse gas reduction objectives. Many countries used the forest sink argument to adjust their GHG reduction effort, arguing even that their own forests took up most of their anthropogenic emissions. Understandably, heated discussions took place with respect to the definition of forests and to the rate of carbon exchange over a forest canopy. Many research projects were launched to deal with what became a critical political issue in the context of the Kyoto Protocol.

During this same decade, people of the forests and their fate became a topic of attention for many government and non-governmental organizations ; many made their plea clearly heard in international fora.

A new agent of forest degradation drew attention during the nineties ; it is related to climate events of the El-Niño type and to their impact on the forest through burning. Large-scale forest fires in Borneo, Sumatra and the Amazon underlined the fact that under intense exploitation pressure the rain forest is getting increasingly vulnerable to drought and fires. Millions of hectares of forests were damaged during the strongest El-Niño episodes of the early nineties. Severe droughts associated with that phenomenon may have provided the trigger for a non-reversible transformation of primary forests into secondary vegetation, the latter being maintained by recurring fires. Those events raised again the question of the long-term impact of climate change on tropical vegetation in the context of intense human interference. At the same time it became

more evident that tropical forests were not only changing because of deforestation itself but also because of a more diffuse degradation linked to fires and selective logging. The characterization of forest degradation consequently became a key topic of study in support to more realistic assessment of changes in the forests of the tropics.

Lately, the sensitive issue of illegal logging has come into the open in international fora. Combating illegal logging is now getting higher on the list of priorities of developed countries trading with tropical producers. The share of illegally logged wood in European imports is important and it is obvious that its reduction can only be brought about through combined efforts between producers and consumers.

## Improving our Current Understanding to Help Policy Making

Tropical deforestation has continued unabated during the last two decades for a variety of interlinked reasons which apply to various combinations at different scales and in different locations. This is why it is important to maintain up-to-date assessments of changes, trends and events affecting the overall conditions of those ecosystems. Equally important is to reassess at regular intervals the role and weight of the stakeholders concerned by the management and preservation of those resources. These regular assessments are further needed because those forces and agents are all active in a changing global economic and climatic context.

Recognizing those facts, the Royal Academy of Overseas Sciences has proposed to hold a series of workshops that will examine the latest information and understanding of tropical deforestation issues. The first workshop will deal with an assessment of the current information related to deforestation in terms of statistics and geographical distribution. It will review the technology currently available for monitoring forest canopies and deforestation. Of particular relevance in that context will be to examine the role of those technologies in fostering transparency and accountability. The workshop will also propose a review of the role of various agents of deforestation and their relative importance in several parts of the tropics.

The second workshop of the series organized by the Academy will focus on an analysis of sustainable development practices as they are currently applied in tropical forest management. Of particular relevance will be to determine whether those practices are realistically applicable

and whether they give to the customer sufficient confidence that wood products come from "green" sources. The role of research and of non-governmental organizations will also be examined in that context.

The third workshop will focus on the linkages between the industrial society and the fate of tropical forest ecosystems. The relevance of the "ecological footprint" concept as an indicator of those links will be examined. Connections between consumption in the western world and the future of tropical forests will be analysed.

The workshops are aimed at a better definition of issues and mechanisms related to tropical deforestation with a view to better informing the public and decision-makers at national level. Their ultimate goal is to contribute to the development of a collective stewardship of the world's natural resources. These results will be presented and reviewed in an international conference which will take place in the course of 2003.

Workshop I (27 May, 2002)

# Monitoring the Evolution of the Tropical Forest Area

*Tropical Forests.*
*A State of the Art at the Turn of the Century*
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# Mapping and Monitoring Tropical Deforestation Using Remote Sensing

by

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In spite of the importance of the world's humid tropical forests, our knowledge concerning their rates of change remains limited (IPCC 1997). The second phase of a research programme (TREES-II — Tropical Ecosystem Environment Observations by Satellite) exploiting the global imaging capabilities of Earth observing satellites has just been completed to provide the latest information on the status of these forests.

The results of the TREES-II programme show that in 1990 there were some 1,150 ± 54 million hectares of humid tropical forest. Furthermore, the 1990-1997 period showed a marked reduction of dense and open natural forests : the annual deforestation area for the humid tropics is estimated at 5.8 ± 1.4 million hectares. This is an area approximately twice the size of Belgium. A further 2.3 million hectares per year of forest are detected as highly degraded — becoming increasingly fragmented, heavily logged and/or burnt. But this consists mainly of young re-growth on abandoned land and partly of new plantations, both of which are very different from natural forests in ecological, biophysical and economic terms, and therefore not appropriate in counterbalancing the loss of old-growth forests.

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These new figures are the most consistent estimates currently available. They show that Southeast Asia is the continent where forests are under the highest threat (0.91 % annual deforestation rate). The annual area deforested in Latin America is similarly large, but the rate (0.37 %) is lower, due to the vast Amazonian forest. The humid forests of Africa are being depleted at a similar rate to that of Latin America.

At the global level, these figures indicate a 23 % lower net forest cover change rate for the tropical humid forests than was generally accepted until now. This has major repercussions on the calculation of carbon fluxes in the global budget resulting in a terrestrial sink smaller than previously inferred.

These results clearly demonstrate the important role of sound scientific evidence to support policy. The close collaboration with local partners in developing countries and international governmental or non-governmental organizations combined with state-of-the-art analysis of satellite imagery has proved a powerful combination. The need for reliable, accurate and consistent information on our planet's resources is steadily growing ; both in the context of multilateral environmental agreements, such as the Framework Convention on Climate Change or the Convention on Biological Diversity, and in the context of international aid, trade and development partnerships. The TREES-II project has shown what can be achieved and paves the way for future global resource monitoring initiatives.

## 1. Introduction

The value of forests to the world's population is becoming increasingly evident. The importance of their role in our planet's functioning is clearly reflected in multilateral environmental agreements such as the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity. Yet demographic, economic and social changes around the world continue to exert considerable pressure on forest cover and condition. Because of their importance to us all, international activities such as those undertaken by the Food and Agriculture Organisation (FAO) of the United Nations (FAO 2001a,b) aim at documenting the status of the world's forests. This is an enormous undertaking and perhaps it is inevitable that not all the world's forests will be documented to the same level of detail.

The humid tropical forests deserve our special attention. Agricultural expansion, commercial logging, plantation development, mining, industry,

urbanization and road building are all causing deforestation in tropical regions (GEIST & LAMBIN 2001). The loss of the forests affects the Earth's physical processes driving our climate and has a profound impact on the biodiversity of our planet. Yet, in spite of their importance, our knowledge concerning their distribution and rates of change remains surprisingly limited.

Initiated in the early 1990s, the TREES project was dedicated to the development of forest cover assessment throughout the tropics. This project made use of an extensive set of remote sensing satellite data. The main objectives of the TREES project were :

— To develop techniques for global tropical forest mapping ;
— To develop techniques for monitoring active deforestation areas ;
— To set up a comprehensive tropical forest information system.

The ultimate goal was to establish an operational observing system that could detect and identify changes in the tropical forest cover of the world.

The primary objectives of the TREES-II phase were to produce relevant information, more accurate than currently available, on the state of the humid tropical forest ecosystems from a new remote sensing-based approach and to analyse this information in terms of deforestation and forest degradation trends.

## 2. Methodological Approach

### 2.1. STUDY DOMAIN

The evergreen and seasonal forests of the tropical humid bioclimatic zone covered by our work correspond closely to those forests defined by FAO as "Closed Broadleaved Forest" (FAO 1993) and by IUCN, The World Conservation Union, as "Closed Forest" (HARCOURT & SAYER 1996). We do not document the woodlands and dry forests of the dry domains except for the monsoon forests in the continental part of Southeast Asia where they are intermixed with the humid forests.

The initial definition of the domain covered by the TREES-II study is :

— The tropical humid forest biome of Latin America excluding the Atlantic forests of Brazil ;
— The tropical humid forest biome of Africa : the Guineo-congolian zone and Madagascar ;

— The tropical humid forest biome of Southeast Asia and India, including the seasonal monsoon forests of continental Southeast Asia.

### 2.2. The General Approach

The different methods of measuring tropical deforestation at a global scale can be grouped into two main categories :

— **Gathering information** through reports, national statistics and independent expert opinions (FAO 1997, 2001a,b). This approach has for main limitation the heterogeneity of results due to differences in methods and definitions.
— **Measuring change using remote sensing** fine resolution satellite imagery. Recent estimates (dated early 1990s) of remaining tropical humid forest *area* have been produced by the TREES project (Mayaux *et al.* 1998) using an original multiscale remote sensing approach. But this method did not allow to assess accurately forest *area change* over a short time period because of the potential errors of using maps from coarse spatial resolution satellite data for *area* estimation.

In the TREES-II project, the second approach was adopted following six main technical steps :

— The establishment of sub-continental forest distribution maps for the early 1990s at 1:5,000,000 scale, derived from 1 km² spatial resolution satellite images.
— The generation of a deforestation risk map, identifying so-called "deforestation hot spot areas" with knowledge from environmental and forest experts from each region.
— The definition of five strata defined by the "forest" and "hot spot" proportions obtained from the previous steps.
— The implementation of a stratified systematic sampling scheme with 100 sample sites covering 6.5 % of the humid tropical domain. The scheme was designed for change assessment by higher sampling probabilities in deforestation hot spot areas.
— The change assessment for each site based on interpretation of fine spatial resolution (20-30 m) satellite imagery acquired at 2 dates closest to our target years (1990-1997), performed by local partners using a common approach.
— The statistical estimation of forest and land-cover transitions at continental level using the data linearly interpolated between the two reference dates : 1st June 1990 and 1st June 1997.

## 3. Mapping Forest Distribution at 1 km Resolution

The first activity of the TREES project relates to the baseline inventory of humid tropical forests. The TREES concept was to provide a wall-to-wall coverage from coarse spatial resolution satellite data (MALINGREAU *et al.* 1994). The results of this first task consist of the 1 km resolution maps of the tropical humid forest cover for the early 1990s. From this database several vegetation maps have been elaborated and reviewed by a panel of regional experts (MAYAUX *et al.* 1999, EVA *et al.* 1999, ACHARD & ESTREGUIL 1995).

These baseline maps are restricted to the tropics and to essentially one thematic class (humid forest) and as such achieve a higher labelling and spatial accuracy by aiming for a lower thematic sophistication. The methods were optimized for this specific class : interpretation of cloud-free single-date images at the middle of the dry season, supervised geometric registration, consultation of many national documents.

The TREES thematic legend was elaborated in order to separate the main ecological forest types relevant for global and regional studies (climate change, biodiversity,...), to be valid at the continental level and to be consistent at a simplified level for the whole tropical belt. As remote sensing and ancillary spatial data are used to produce the map, a hierarchical classification system using was defined : physiognomy (mainly the tree crown closure or forest cover percentage), seasonality (within-year evolution of the vegetation canopy greenness) and topography (altitude).

At the same time as producing these coarse spatial resolution maps, a sample of fine spatial resolution data across the tropics was collected so as to perform the accuracy assessment and area correction exercises (MAYAUX *et al.* 1998) (tab. 1).

These maps were recently updated and extended to the other vegetation types using SPOT VEGETATION images in the frame of the Global Land Cover 2000 project (EVA *et al.* 2004, MAYAUX & MALINGREAU 2000, MAYAUX *et al.* 2004, STIBIG *et al.* 2001) (fig. 1).

**Table 1**

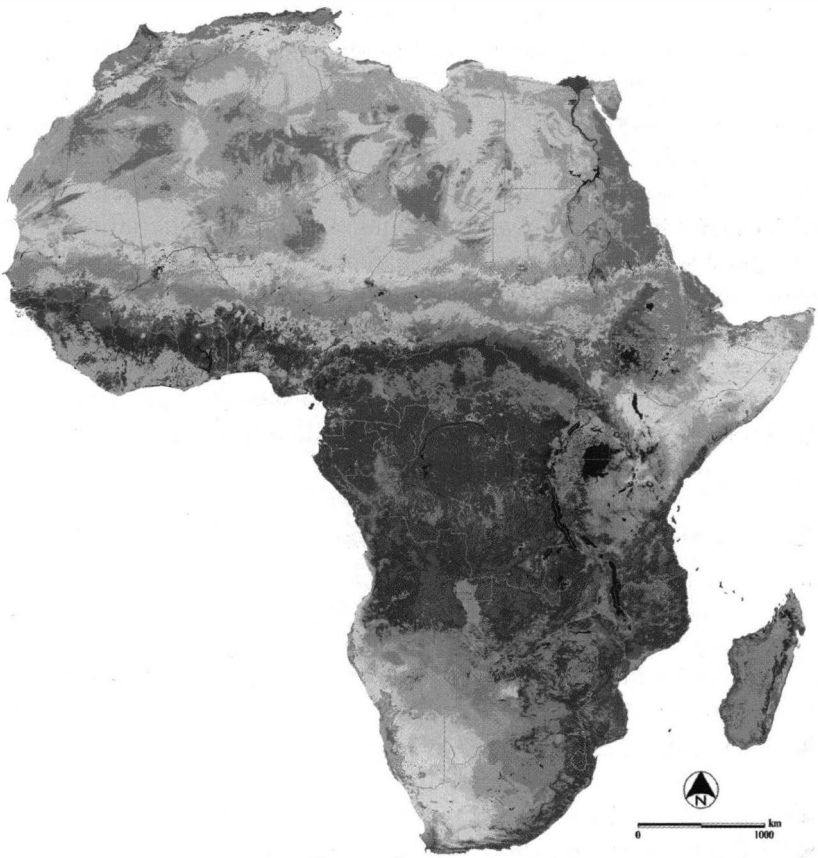
Forest area derived from the TREES-I coarse resolution maps, after the correction procedure

| Region | TREES Dense Forest | FAO Closed Broadleaved Forest | IUCN Closed Forest |
|---|---|---|---|
| Central Africa | 183,967 | 158,300 | 185,802 |
| West Africa | 17,859 | 15,569 | 13,470 |
| **Africa** | **201,826** | **173,869** | **199,273** |
| Central & Caribbean | 50,887 | 27,629 | 76,970 |
| South America | 652,772 | 637,050 | 615,605 |
| **America** | **703,659** | **664,679** | **692,575** |
| Continental SE Asia | 83,914 | 72,030 | 74,193 |
| South Asia | 21,810 | 30,480 | 19,299 |
| Insular SE Asia | 173,690 | 143,390 | 177,725 |
| **Asia** | **279,414** | **245,900** | **268,217** |
| | | | |

## 4. Identification of "Deforestation Hot Spot" Areas

Deforestation risk areas were identified using the baseline forest cover maps of the early 1990s in conjunction with knowledge from forestry and environmental experts. These areas were spatially delineated and documented on regional maps for the three continents, the so-called "deforestation hot spot areas" (ACHARD *et al.* 1998). A "deforestation hot spot area" is an area where major changes of the forest cover were thought to be occurring during the 1992-1997 period, or were expected to take place in the subsequent years : 1998-2002. The final objective was to use the hot spot delineation in the framework of a more complex remote sensing-based monitoring system.

The exercise conducted during the TREES expert meeting held in November 1997 led to the production of three continental tropical forest "hot spot" maps, which include the main areas of active present or expected near-future forest cover change. These deforestation "hot spot" maps were then updated after the expert meeting with more recent information and were restricted to the active deforestation areas during the early 1990s.




Legend

*Land-cover classes with a dominant tree layer*

- Closed evergreen forest
- Degraded evergreen forest
- Closed deciduous forest
- Swamp forest
- Mangrove
- Forest / Croplands
- Croplands / Natural vegetation

*Land-cover classes with a dominant grass layer mixed with agriculture*

- Closed deciduous woodland
- Open deciduous woodland
- Closed shrubland with sparse trees
- Closed shrubland
- Open shrubland with sparse trees
- Open shrubland
- Closed grassland
- Open grassland with sparse trees
- Open grassland
- Sparse grassland
- Swamp bushland and grassland

*Land-cover classes with dominant agriculture*

- Rain-fed agriculture
- Irrigated agriculture
- Orchards

*Other land-cover classes*

- Bare soil
- Salt hardpans
- Waterbodies

Fig. 1. — The Global Land Cover Map of Africa for the year 2000.

The picture, which emerged at the end of the analysis conducted during the "hot spot" meeting, was a relatively bleak one. The hot spot maps dramatically illustrate that deforestation is an on-going process, which insidiously continues to affect larger areas. The information presented on these maps is cause for concern because it seems to indicate that the processes are steam rolling over large areas and may be irreversible. One cannot avoid adopting a very fatalistic attitude when confronted with these facts. The apparent irreversible decline of natural forest resources leads one to seriously consider whether conservation efforts should maintain a focus on sustainable forest management practices. Considering that agricultural expansion is probably the main cause of deforestation, one may wish instead to concentrate on the preservation of a few intact areas not identified as current or impending hot spots, that one might call "cool spots".

### 4.1. Latin America

The South American tropical rain forest domain is currently exploited along a large belt extending from the eastern to the southern portions of the Amazon basin. Large areas of deforestation are found on the Peruvian and Ecuadorian lower foothills of the Andes. Inside the basin, pockets of deforestation are associated with settlements and roads. Deforestation is reported to be on the increase in the coastal forests of Colombia and Ecuador and in Guyana. In Central America, the forest remnants are highly fragmented. Fragments are being progressively reduced and only inaccessible and conservation areas seem to be somewhat secure. Agricultural expansion and new settlements are the main causes of deforestation for this continent.

### 4.2. Central Africa

In Central Africa, significant deforestation is limited to a few areas. Deforestation is mainly associated with logging in Cameroon and Gabon, and with the supply of fuel wood to major urban centres of the region. Deforestation/forest expansion in the *zone périforestière* is an important element of the sub-continental forest cover budget. The situation in the eastern part of the Democratic Republic of Congo is said to be ripe for a major push in deforestation (*i.e.* logging and conversion to pastures in Ituri) pending improvement in access and security. The situation in the Congo Basin is still relatively quiet on the deforestation front. Large-

scale logging or significant agricultural expansion are not expected to take place very soon. Furthermore, the secondary forest vegetation may act as a buffer if an acceleration of swidden cultivation takes place at the local level.

### 4.3. Southeast Asia

The situation in Southeast Asia is more worrisome considering that current or near-future "hot spots" cover the majority of the forest remnants of the continental Southeast Asia and of the Indo-Malay Archipelago. The extensive forest resources of northeastern India are under intensive exploitation for timber and conversion to agriculture. Selective to clear-cut logging affects many parts of Myanmar and Cambodia. The impact of shifting cultivation of forest resources of Myanmar is believed to be on the increase. Laos has little forest left in the north and the southern forest cover is increasingly threatened by logging. Plans for China to open various access roads/railways from Yunnan to the Andaman Sea are likely to have a serious impact on the forest remnants of the "golden triangle". Forest conversion is taking place on a large scale in Central Vietnam and forest fragments in the North are rapidly being eroded. The situation in Sumatra is particularly striking : forests have virtually disappeared under the pressure of agriculture and plantations along a wide central south-north belt. A similar situation is developing in Kalimantan. No reversal of such trends is likely to emerge in the near future.

## 5. Mapping Forest Cover Changes over the Tropics

### 5.1. Sampling of the Observation Units

Based on the two information layers : forest cover baseline and the deforestation hot spot areas, a framework was established for the selection of a sample of around 100 observation sites across the tropics selected in a statistical manner with higher sampling probabilities for fast changing areas.

A stratification was established for the selection of a pre-sample. Using a *hotness index*, five strata were defined ranging from low change rate, *i.e.* areas with no hot spot and high forest cover, to high change rate, forest areas within the hot spots (fig. 2). The stratification was used for

the selection of 102 compulsory observation sites covering 6.5 % of the humid tropical domain.

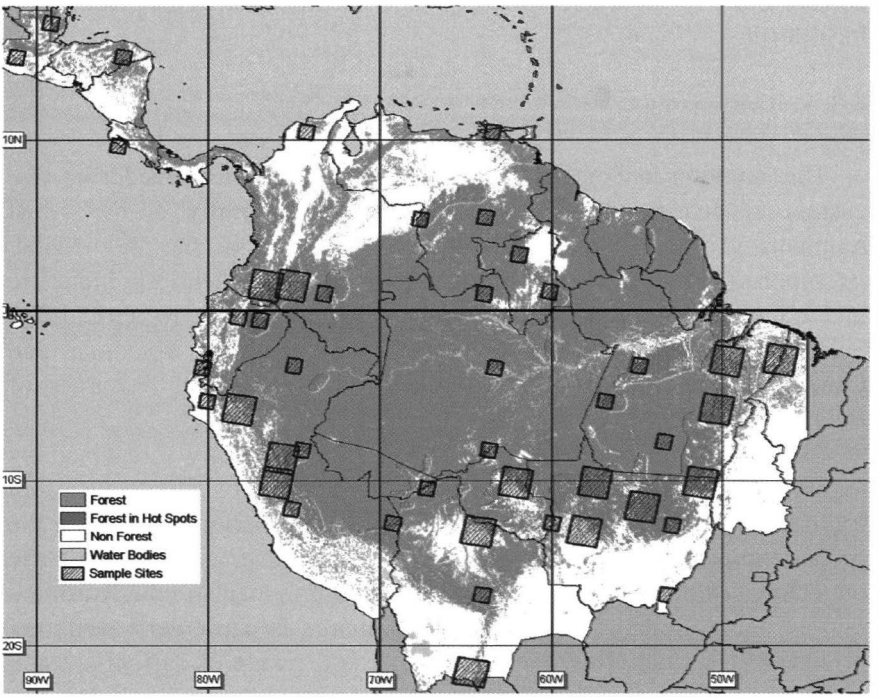



Fig. 2. — Location of observation units in Latin America.

## 5.2. Deforestation Mapping within the Observation Units

*Forest cover* and *forest cover change* have been mapped over the 102 observation sites, statistically distributed over the humid tropics. Mapping has been done by visual interpretation of the fine spatial resolution (20 m to 30 m) satellite imagery from Landsat TM and SPOT HRV sensors, displayed on the screen. The best satellite images have been selected from the existing acquisitions and at two dates closest to our target years : 1990 and 1997.

Satellite image interpretation has been carried out with a common standardized method by a network of twenty local experts or institutions having an extensive knowledge of the local forest conditions and change processes. The mapping of changes in land cover was performed in an "interdependent way", *i.e.* by overlaying the interpretation results of the historical image on the recent data set and by only updating the polygons

that changed. Errors of interpretation were minimized by alternate comparison of the historical and the recent image during delineation : the introduction of "slivers" can be avoided and at the same time corrections can be applied to those polygons wrongly assigned or delineated in the historical data set.

The primary objective of image interpretation was to map for each sample site forest cover at the two dates of satellite image acquisition in order to assess changes from forest to non-forest or vice versa. The TREES forest and land-cover classification scheme was defined mainly for this purpose. However, as far as possible from satellite images, forest and vegetation cover was mapped at more detail than required for an assessment of forest versus non-forest. This was done in order to provide a more complete view of land-cover change within the individual test sites, but also to obtain indication on processes going on within the forest cover, forest namely degradation and fragmentation (fig. 3).

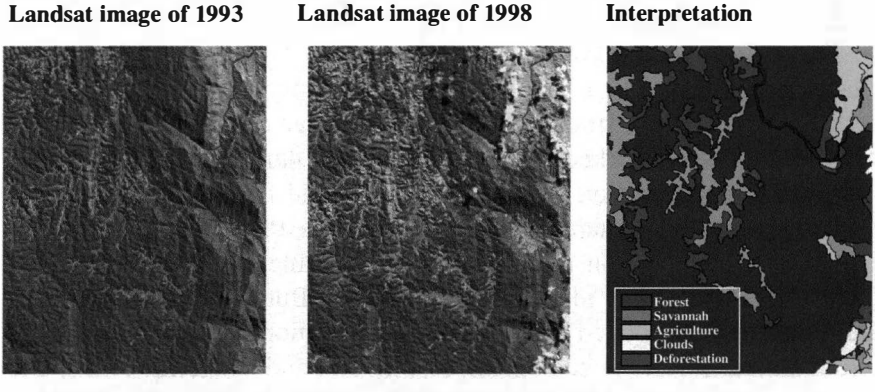



Fig. 3. — Image interpretation procedure over an observation unit in Madagascar.

As various partners performed the satellite image interpretation, a study of the consistency of the classification and interpretation procedures implemented was considered necessary. The consistency assessment was based on the re-interpretation of spatial subsets (blocks) extracted from the original data sets provided by the TREES partners.

The resulting interpretation consistency has been estimated at 93 % globally for the ten aggregated land-cover classes (closed, open or fragmented forests, plantations, regrowth, mosaics, natural non-forest, agriculture, non-vegetated, water) with the following continental distribution : 96 % for Latin America, 88 % for Africa and 92 % for Southeast Asia.

For the forest cover change estimations, the global consistency was estimated at 91 % with 96 % for Latin America, 82 % for Africa and 90 % for Southeast Asia.

## 6. Forest Cover Change Estimation at Continental Level

The *forest cover* and other *land cover areas* measured from the digital on-screen interpretations of the 102 observation units (samples) were standardized and linearly interpolated to the two reference dates : 1st June 1990 and 1st June 1997. *Forest cover change* and *land cover transitions* were then estimated statistically at continental level using the extrapolated data. To derive continental and global estimates, it was necessary to expand the area estimates upon the data from the 102 individual sample measurements, which are covering only 6.5 % of the study area. This is done by statistical calculation which takes into account the selection probabilities and variances per stratum.

This study shows that in 1990 (the Kyoto Protocol baseline year) there were some 1,150 ± 54 million hectares of humid tropical forest. The estimation of global tropical humid forest cover change for the period 1990-97 shows a marked reduction of natural dense and open forests : the annual deforestation [1]* rate for the humid tropics is estimated at 5.8 ± 1.4 million hectares with a further 2.3 ± 0.7 million hectares of forest with degradation measurable from satellite imagery. Large non-forest areas were also re-occupied by forests. But this is mainly young re-growth on abandoned land and partly plantations, both very different from natural forests in ecological, biophysical and economic terms, and therefore not appropriate to counterbalance for the loss of old-growth forests.

Globally, the main forest conversion process in the humid tropics is the transformation from closed, open or fragmented forests to agriculture with 3.09 $10^6$ ha $yr^{-1}$ with specific situations for each continent. Indeed, deforestation within the three regions is not uniformly distributed but the actual changes are confined to a number of "hot spot" areas where change rates are alarmingly high. We documented annual rates of change of more than 3 % in various sample sites.

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* The number in brackets [ ] refers to the note, p. 56.

The three continents reveal considerable differences in change rates (tab. 2). Southeast Asia has the highest annual rate of deforestation and Africa is losing its forests at about half this rate. Latin America shows the lowest deforestation rate but with 2.5 $10^6$ ha $yr^{-1}$ the annual loss is almost the same as that estimated for Southeast Asia.

Forest degradation shows a similar overall pattern. It is most prominent in Southeast Asia, intermediate in Africa and lowest in Latin America. It is worth mentioning that these estimates represent only the degradation proportion, which can be identified from satellite imagery and do not include processes such as selective removal of trees.

Reforestation is dominant in Southeast Asia, however mainly through the transition of former mosaics and woodland cover to forest. It is found to a lesser extent in Latin America and limited in Africa.

**Table 2**

Humid tropical forest cover estimates for the years 1990 and 1997 and mean annual change estimates during the 1990 to 1997 period. Estimation ranges are at 95 % confidence

| | **Latin America** ($10^6$ ha) | **Africa** ($10^6$ ha) | **Southeast Asia** ($10^6$ ha) | **Global** ($10^6$ ha) |
|---|---|---|---|---|
| Annual deforested area rate | 2.5 ±1.4<br>0.38 % | 0.85 ±0.30<br>0.43 % | 2.5 ±0.8<br>0.91 % | 5.8 ±1.4<br>0.52 % |
| Annual regrowth area rate | 0.28 ±0.22<br>0.04 % | 0.14 ±0.11<br>0.07 % | 0.53 ±0.25<br>0.19 % | 1.0 ±0.32<br>0.08 % |
| Annual net cover change rate | - 2.2 ±1.2<br>0.33 % | - 0.71 ±0.31<br>0.36 % | - 2.0 ±0.8<br>0.71 % | - 4.9 ±1.3<br>0.43 % |
| Annual degraded area rate | 0.83 ±0.67<br>0.13 % | 0.39 ±0.19<br>0.21 % | 1.1 ±0.44<br>0.42 % | 2.3 ±0.71<br>0.20 % |

The main global land-cover change process is the transformation from closed, open or fragmented forests to agriculture with 21.6 million hectares deforested over the 1990-1997 period (tab. 2). Deforestation within the three regions is not uniformly distributed but the actual changes are confined to a number of "hot spot" areas where change rates are alarmingly high in particular when located in high biodiversity zones. We documented annual rates of change of more than 3 % per sample site in various hot spots around the world.

The spatial detail and ability to compare different geographical regions provided by this work reveals considerable variation around the world. Southeast Asia has the highest annual rate of deforestation at 0.91 %, Africa is losing its forests at about half this rate, at 0.43 %, and at 0.37 % Latin America shows the lowest deforestation rate but at 2.5 million hectares per year the annual loss is almost the same as that loss in Southeast Asia. Forest degradation shows a similar overall pattern. It is most prominent in Southeast Asia : 0.42 %, intermediate in Africa : 0.21 % and lowest in Latin America : 0.12 %. But these estimates represent only the degradation proportion that can be identified from satellite imagery and does not contain processes such as selective removal of trees. Reforestation is dominant in Southeast Asia, however mainly through the contribution of former mosaics and woodland cover now interpreted as forest, to a lesser extent in Latin America (0.28 million hectares/year) and limited in Africa (0.14 million hectares/year).

### 6.1. Latin America

Whilst the net regional forest change rate for Latin America is relatively low (0.33 %), the overall annual gross deforestation of humid forests is significant (2.5 $10^6$ ha $yr^{-1}$).

Deforestation in Latin America is confined to several "hot spots" (tab. 3) where remaining forests are increasingly fragmented or are already heavily logged and burnt. The prognosis is that such forest remnants will soon disappear. It is then expected that new hot spots will appear. Large areas of forest are also becoming isolated at the regional level, highlighting the urgent need for establishing biological corridors.

The transformation from closed, open or fragmented forests to agriculture by clear-cutting is a predominant factor. Moreover, 3.61 $10^6$ ha $yr^{-1}$ of mosaics or savannas-woodlands were transformed into agriculture. Increase of the agriculture land is the major cause of deforestation in this continent. Two thirds of these transformations are happening in the Brazilian Amazon region.

### 6.2. Africa

The estimated rate of deforestation for Africa is higher than Latin America (0.43 %) with very high local rates for Madagascar and Côte d'Ivoire, which are not compensated by re-growth. On this continent 310,000 ha $yr^{-1}$ of forests were transformed to agriculture with a further

280,000 ha $yr^{-1}$ into mosaics and 200,000 ha $yr^{-1}$ into savannas or woodlands.

The causes of deforestation are manifold from agricultural encroachment and illegal logging in Cameroon, urban expansion in the Democratic Republic of Congo (DRC) or refugees' migrations in Liberia and eastern DRC. Shifting cultivation mainly occurs in the mosaics of secondary forests and affects only partially the closed primary forests. Agricultural colonization follows a diffuse spatial pattern, with a particular population pressure in eastern DRC. Selective forest logging plays an indirect role allowing the opening of the forest cover by exploitation roads. The hunting pressure from poachers, which is the main environmental problem in Central Africa, is then increased.

### 6.3. Southeast Asia

The overall trend of continuing deforestation appears almost unchanged for Southeast Asia. The forest cover change estimate for Southeast Asia indicates a high annual deforestation rate (0.91 %) for the humid forest domain and in addition a substantial annual rate of "visible" degradation.

The importance of separate estimates for deforestation and reforestation could be seen for individual countries as for example for Vietnam. Country net figures of forest change including reforestation of fast growing forest plantations mask easily ongoing deforestation of old growth as apparent in the individual sample sites.

In total, 1.06 $10^6$ ha $yr^{-1}$ of forests were converted into agriculture and 650,000 ha $yr^{-1}$ into mosaics. A further 550,000 ha $yr^{-1}$ were degraded into savannah or woodlands. At the same time some 650,000 ha $yr^{-1}$ of mosaics or savannah-woodlands changed to agriculture.

Among others, the main factors for deforestation in Southeast Asia are unsustainable and illegal logging, the conversion of old-growth forests to plantations for pulp and paper and the conversion of forests to agriculture and cash crop production, particularly in the insular part of the continent. Shifting cultivation plays a more important role in the continental part. However, as shifting cultivation has existed there for a long time it mostly does not occur in primary forests anymore, and also large parts of the shifting cultivation mosaics do not contain high forests anymore, but instead, relative young re-growths.

**Table 3**
Annual deforestation rates in hot spot areas

| Hot spot areas by continent | Annual deforestation rate of sample sites |
|---|---|
| ***Latin America*** | ***0.38 %*** |
| Central America | 0.8 % to 1.5 % |
| Brazilian Amazonian belt | |
| Acre | 4.4 % |
| Rondonia | 3.2 % |
| Mato Grosso | 1.4 % - 2.7 % |
| Para | 2.4 % |
| Colombia / Ecuador border | around 1.5 % |
| Peruvian Andes | 0.5 % to 1.0 % |
| ***Africa*** | ***0.43 %*** |
| Madagascar | 1.4 % to 4.7 % |
| Côte d'Ivoire | 1.1 % to 2.9 % |
| ***Southeast Asia*** | ***0.91 %*** |
| South-eastern Bangladesh | 2.0 % |
| Central Myanmar | around 3.0 % |
| Central Sumatra | 3.2 % to 5.9 % |
| Southern Vietnam | 1.2 % to 3.2 % |
| South-eastern Kalimantan | 1.0 % to 2.7 % |

Our new estimates can contribute to further reduce uncertainties in carbon net flux from deforestation and re-growth in the humid tropics. In the debate related to Global $CO_2$ budgets, "there remain large uncertainties associated with estimating the $CO_2$ release due to land-use change (mainly tropical deforestation)" (ALBRITTON *et al.* 2001). These scientific uncertainties can be grouped into three main categories : *i)* the true level of tropical deforestation ; *ii)* the amount of biomass for different forest types ; *iii)* the spatial distribution of these forest types. Following our new estimates of tropical deforestation and using standard methods for assessing the fluxes, a maximum estimate of global net emissions from land-use change in the tropics would be about 0.96 Gt C $yr^{-1}$. Even if this latter figure does not include loss of carbon from forest degradation, which is much more difficult to estimate, it leads us to believe that the residual terrestrial uptake must be smaller than previously inferred.

## 7. Conclusions

For the 1970s it has been realized that forest monitoring is required not only at the national but also at the regional and global levels. Regional and sub-regional organizations rely on consistent information on the forest resources for developing forest and environmental strategies above the national level. The need for global data has further increased in the context of environmental conventions (*e.g.* Convention on Biodiversity) and most recently for global climate modelling.

For a number of tropical countries reliable information is not available at all. Furthermore, the aggregation of national statistics has proved to be extremely difficult, due to incompatible definitions and inventory methods, often completely outdated. This is why FAO, charged with providing global forest statistics, had to rely on national data partly from the 1980s and sometimes on expert estimates. Reliable information on forest cover *change* is even more difficult to obtain. As a consequence, IPCC (WATSON *et al.* 2000) stated that deforestation figures for tropical countries could be in error as much as 50 %.

With satellite remote sensing technology, one can produce independent and up-to-date estimates. The project focused on tropical humid forests because they are heavily threatened, and they contain the highest biodiversity and much higher biomass than in the temperate forests or in the dry tropical forests.

The main results of the current work are:

— ***Deforestation is 23 % lower than previously estimated from other sources*** : the TREES project reduced one of the major uncertainties in the determination of global deforestation rates. Even if total deforestation rates in the tropics might be a bit lower than expected, the impact of the present rate may be even more severe than in previous decades, because these resources have become a "limited" asset. Future collaboration between the EC Joint Research Centre and FAO could also refine the estimates.

— ***Gross global deforestation of humid forests is at 5.8 million hectares per year*** : the magnitude of forest destruction remains enormous : the annual gross deforestation is twice the size of Belgium.

— ***Degradation is also very large (2.3 million hectares per year)*** : the magnitude of forest degradation indicates that the process of deforestation will continue. We can assume that forest degradation affects

in total much larger areas than the ones detected by our method (selective logging, non-sustainable management).

— ***Carbon emissions from land-use change in the tropics are lower than those reported until now (~1 Gt C yr$^{-1}$)*** : a significant advance was made towards reducing one of the major scientific uncertainties in estimating carbon emissions from the loss of humid forests. If the general assumption on the role of tropical forests for the carbon cycle is valid, less deforestation releases less carbon. Conversely, this means that terrestrial uptake is lower than assumed up to now.

Forest inventory, accounting and statistical work to improve the quality of environmental data and environmental indicators and the building-up of compatible public data banks are a necessary step towards the sustainable development and environmental protection of the world's forest resources.

Through this study important new findings demonstrate that deforestation in the humid tropics is still a major global environmental issue and one deserving of sustained attention.

All the digital data (maps and detailed statistics) can be downloaded from the Web at the addresses : http://www.gvm.jrc.it/Forest/defaultForest.htm and http://www.gvm.jrc.it/glc2000/defaultGLC2000.htm

## DISCLAIMER

The views expressed are purely those of the writer and may not in any circumstances be regarded as stating an official position of the European Commission.

## NOTE

[1] Deforestation is defined as the conversion from forest (closed, open or fragmented forests, plantations and forest re-growths) to non-forest lands (mosaics, natural non-forest such as shrubs or savannas, agriculture and non-vegetated). Reforestation (or re-growth) is the conversion of non-forest lands to forests. Degradation is defined as the process within the forests whereby there is a significant reduction in either tree density or proportion of forest cover (from closed forests to open or fragmented forests).

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# Causes and Pathways of Tropical Deforestation

by

Eric LAMBIN * & Helmut GEIST **

## Introduction

The literature is rich in local-scale case studies investigating the causes of tropical deforestation in specific localities. While such studies reveal complex and diverse stories on land-use change trajectories, they lack generality and geographical representativity. We aimed at extracting a general understanding on the causes and drivers of tropical deforestation while preserving the richness of explanation found in local-scale case studies. We ran a frequency analysis of the occurrence of underlying driving forces and direct causes of deforestation, including their interactions, as reported in 152 subnational case studies (GEIST & LAMBIN 2002).

This meta-analysis has shown that tropical deforestation is driven by identifiable regional variations of synergetic cause/driver combinations in which economic factors, institutions, national policies and remote influences are prominent. Findings reveal that too much emphasis has been given to population growth and shifting cultivation as primary causative variables of deforestation. Moreover, deforestation is not a homogenous process throughout the tropics ; the succession of causes and events leading to tropical deforestation varies in a major way between Latin America, Southeast Asia, and Africa (LAMBIN & GEIST 2003). Three sets of factors lead to these regional variations : the environmental and land-use history of each region, which defines the initial conditions for each subsequent round of land-use change ; the particular

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combination of causes triggering and driving land-use change ; and the feedback structure, that is, the social and ecological responses to land-cover changes affecting rates of change. Understanding "pathways of land change" — particular chains of events and sequences of causes and effects leading to specific land-cover changes — is crucial for designing appropriate policy interventions. To achieve a sustainable management of ecosystems, policy interventions have to be fine-tuned to region-specific causes of forest-cover change.

## Direct Causes

At the proximate level, tropical deforestation is best explained by multiple factors rather than by single variables. Dominating the proximate causes is the combination of agricultural expansion, wood extraction and extension of infrastructure, with clear regional variations.

Agricultural expansion is, by far, the leading process of land-use change associated with next to all deforestation cases. It includes, with more or less equal frequencies, forest conversion for permanent cropping, cattle ranching, shifting cultivation and colonization agriculture. Only permanent agriculture and shifting cultivation display low geographical variation. Further subdivisions reveal however striking regional differences. In shifting cultivation, cases of deforestation driven by swidden agriculture are more widespread in upland and foothill zones of Asia than elsewhere, with slash-and-burn agriculture by colonizing migrant settlers mainly limited to lowland areas of Latin America. In permanent cultivation, the expansion of food crop cultivation for subsistence is three times more frequently reported than the expansion of commercial farming. Pasture creation for cattle ranching is a striking factor of deforestation almost exclusively in humid lowland cases from mainland South America.

While commercial wood extraction is frequent in both mainland and insular Asia, the harvesting of fuel-wood and poles for domestic uses dominates the African cases of deforestation. Among all forms of infrastructure expansion, road construction is by far most frequently reported, mainly in both lowland and mountain cases of Latin America.

Predisposing environmental factors such as land characteristics (soil quality, topography) or trigger events, whether biophysical (droughts, floods) or social (mainly wars), are reported to influence deforestation in one third of the cases.

Among the detailed categories of direct causes and for all regions, the extension of overland transport infrastructure, followed by commercial wood extraction, permanent cultivation and cattle ranching, are the leading proximate causes of deforestation. Contrary to widely-held views, case study evidence suggests that shifting cultivators are not the primary actors responsible for deforestation.

## Underlying Driving Forces

At the underlying level, tropical deforestation is also best explained by multiple factors and synergetic driver combinations rather than by single factor causation, with one third of the cases being driven by the full interplay of economic, institutional, technological, cultural and demographic variables.

Economic factors are prominent underlying forces of tropical deforestation. Commercialization and the growth of, mainly, timber markets (as driven by national and international demands) are frequently reported to drive deforestation as well as market failures. Economic variables such as low domestic costs (for land, labour, fuel or timber), product price increases (mostly for cash crops), and the ecological footprint of remote urban-industrial centres underpin about one third of the cases each, while the requirement to generate foreign exchange earnings at a national level intervenes in a quarter of the cases. With few exceptions, factors related to economic development through a growing cash economy show low regional variations and, thus, constitute a robust underlying force of deforestation. A number of case studies describe a process of frontier colonization with a sequence of poverty- and capital-driven deforestation. The former refers to the ecological marginalization of farmers who have lost their resource entitlements, while the latter refers to public or private investments to develop the frontier for political, economic or social reasons.

Institutional factors also drive many cases of deforestation. These factors mainly include formal "pro-deforestation" measures such as policies on land use and economic development as related to colonization, transportation or subsidies for land-based activities. Land tenure arrangements and policy failures (such as corruption or mismanagement in the forestry sector) are also important drivers of deforestation. Though much discussed as a general cause of deforestation, property right issues are mainly a characteristic of Asian cases and tend to have ambiguous

effects upon forest cover : insecure ownership, quasi open access conditions, maladjusted customary rights as well as the legalization of land titles are all reported to influence deforestation in a similar manner.

Among technological factors, important processes impacting upon deforestation are agro-technological change, with agricultural intensification having no distinct impact from agricultural expansion, and poor technological applications in the wood sector (leading to wasteful logging practices).

Cultural or socio-political factors are reported to underlie mainly economic and policy forces in the form of attitudes of public unconcern towards forest environments. These factors also shape the rent-seeking behaviour of individual agents causing deforestation.

Among demographic factors, only in-migration of colonizing settlers into sparsely populated forest areas, with the consequence of increasing population density there, shows a notable influence on deforestation. It tends to feature African and Latin American rather than Asian cases. Contrary to a common misconception, population increase due to high fertility rates is not a primary driver of deforestation at a local scale, over a time period of a few decades, as it intervenes in 8 % of the cases only, and is always combined with other factors.

## Interactions

It is not only the occurrence of multiple causal factors but also the nature of their interactions which is important to understand the systems dynamics leading to deforestation. The meta-analysis reveals that, in most cases, three to four underlying causes are driving two to three proximate causes. A frequent pattern of causation is road construction associated with wood extraction and/or agricultural expansion, being mostly driven by policy and institutional factors, but also by economic andcultural factors. Pro-deforestation state policies aimed at land use and economic development (*e.g.* credits, low taxation, incentives for cash cropping, legal land titling) lead to the expansion of commercial crops and pastures in combination with an extension of the road network. Differently, insecure ownership related to uncertainties on land tenure and the shift, mostly in Africa, from communal to private property underlie cases in which traditional shifting cultivation is a direct cause of deforestation. Policies facilitating the establishment of state agricultural and forestry plantations which lead to deforestation is a special feature of

both insular and continental Asia. Agricultural colonization in Latin America is often favoured by land policies which are directed towards deregulation of land access, transfer of public forest land to private holdings, and state regulations in favour of large individual land holdings.

Policy, institutional and economic factors are also driving wood extraction. Cases of deforestation related to both private and state-run timber logging, especially in Asia, are almost exclusively driven by the liberal granting of concessions, development projects, and state claims for logging areas, in conjunction with corruption and poor implementation of forestry rules.

In-migration and, to a much lesser degree, natural population growth drive the expansion of cropped land and pasture in half of the cases, in concomitant occurrence with other underlying drivers. The extension of permanently cropped land for subsistence farming to meet the needs of a growing population is reported in particular from African cases. Expansion of pastures features exclusively cases from mainland South America, in association with processes of both planned colonization and spontaneous settlement by colonist agriculturalists.

## Positive and Negative Feedbacks

Pathways of deforestation have built-in feedback loops that amplify or attenuate the impact of the causes of deforestation. Some feedbacks amplifying the process of deforestation were identified. After some initial deforestation, road construction and the creation of new settlements in a frontier area reinforce economic incentives for further deforestation through the growth of local, mostly urban, markets for wood and food. The development of new infrastructures (for example, electricity, water supply, and transportation) by the state, following the colonization of a forest area, also accelerates population growth by attracting new migrants. Commercialization of agricultural products induces further agricultural modernization, which is accompanied by even more deforestation when shifting cultivators turn into sedentary cash croppers and permanently settled subsistence farmers responding to market signals. Finally, state land claims for logging, transmigration/colonization settlements, or agro-industrial plantations, initiate self-reinforcing land races once local farmers perceive or expect land scarcity and conditions of land enclosure, for example by the creation of a conservation area or the allocation of logging concessions to private companies, as in upland areas

of Southeast Asia. All these factors lead to a spiral of accelerating deforestation once it has been initiated.

Other feedbacks play in the opposite direction and slow down deforestation. Initial settlers in a new forest environment can move to nearby cities or non-agrarian production facilities to seek nonfarm employment once the land productivity of their farms declines, a few years after forest clearing. Their outmigration from the forest frontier can trigger spontaneous reforestation on marginal soil while land with a high potential is cultivated more intensively. Pastures cleared out of the forest are rarely active for more than ten years, and although successional regrowth after abandonment is greatly delayed, it will eventually take place once production activities are redirected from an agrarian to an industrial or service-oriented economy. Planting commercially valuable trees can sometimes accelerate reforestation. These new forests are, however, very poor in biodiversity compared to primary forests. The plots that continue to serve as cropland benefit from inputs that are invested by smallholders (individuals who rent or own a small piece of cultivated land) who pursue economic activities in both urban and rural settings at the frontier. Nonfarm income thus allows for both a reduction in deforestation and an increase in the intensity and sustainability of the farming activities. These trends can be supported by continued road improvements, which create new opportunities for perennial crops and dairy production. These evolutions and others such as land improvements (for example, terracing of hills), professional forestry management, and temporary support for emerging sectors by the state, such as ecotourism, contribute to both an ecological restoration at the forest frontier and to the well-being of the people of the region.

## Conclusion

Empirical case study evidence, identifying direct causes and underlying forces of tropical deforestation, suggests that no universal cause-effect linkage is found. Tropical forest decline is determined by different combinations of various proximate causes and underlying drivers in varying geographical and historical contexts. Some of these combinations are robust geographically (such as the development of market economies and the expansion of permanently cropped land for food), while most of them are region-specific. The observed synergetic cause/driver combinations challenge single factor explanations which put most of the blame of

deforestation upon shifting cultivators and population growth (caused by natural increment). Rather, our meta-analysis reveals that, at the underlying level, public and individual decisions largely respond to changing, national- to global-scale economic opportunities and/or policies, as mediated by local-scale institutional factors, and that, at the proximate level, regionally distinct modes of agricultural expansion, wood extraction and infrastructure extension prevail in causing deforestation.

As a major implication, case study-based evidence reveals that no universal policy for controlling tropical deforestation can be conceived. Rather, a detailed understanding of the complex set of proximate causes and driving forces affecting forest cover changes in a given location is required prior to any policy intervention. Many factors that are among the causes of deforestation are also part of the solution — such as land-use policies, economic development, technological innovation, institutional arrangements, and transportation infrastructure. Any optimal policy package to control deforestation is very likely to contain at least the following measures : improving governance, fighting corruption, decentralizing forest management with a concomitant increase in the local capacity to enforce law, developing public participation in environmental planning, and designing creatively new institutional instruments (including market-based ones).

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# Report

by

Raoul DUDAL *

Tropical forests are key resources for the well-being of mankind and are ecosystems which are critical for a sound environment. Changes in the extent and condition of the tropical forest cover in parts of Africa, Asia and South America have given rise to much public concern. The Royal Academy of Overseas Sciences considers that the protection and sustainable management of tropical forests constitute a major development and environmental challenge in this early millennium. Through its "Environment and Development" Commission the Academy has undertaken to give increased visibility to this issue by organizing three workshops in the course of 2002 and 2003, dealing successively with taking stock of the current state of tropical forests, assessing whether sustainable management practices are being applied and identifying linkages between the evolution of tropical forests and consumption trends in the industrial society. It is the intention that these three workshops will provide the basic material for the holding of an international conference, in 2004, devoted to "Tropical forests in a changing global context".

The first of the three workshops was held on 27 May 2002, in the premises of the "Palais des Académies" in Brussels, under the title : "Monitoring the Evolution of the Tropical Forest Area".

The workshop was opened by Prof. Y. Verhasselt, Permanent Secretary of the Academy, and by Prof. M. De Dapper, Chair of the "Environment and Development" Commission.

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The workshop was *introduced* by **J.-P. Malingreau**, Joint Research Centre of the European Commission and Chair of the working group for tropical forests. The purpose of this workshop was to take stock of the present state of tropical forest, to identify the agents of change and to assess the relevance of current and future monitoring activities. It was expected that the workshop would contribute to answering a number of questions in this respect, such as :

— Does global monitoring make sense ? Who needs it ?
— What is the object of monitoring ? Is there a priority (hierarchy) among parameters ?
— Can monitoring required at various levels of aggregation (scales) or for different purposes be tested ?
— Is there a need for continuity ?
— Does monitoring support transparency ?
— Who are the stakeholders in monitoring systems ?
— Should we do things differently from now on ?

**P. Mayaux *et al.***, Joint Research Centre of the European Commission. — *Mapping and Monitoring Tropical Deforestation Using Remote Sensing.*

The objective of the TREES (Tropical Ecosystem Environment Observations by Satellite) project is to develop a monitoring system of tropical forests based on earth observation data. The challenge was to develop improved methods allowing the obtention of accurate information. The outputs of the project are the establishment of an extensive database, the validation of statistical data provided at country and regional level, and quantifying the forest cover area and the rate of change. The purpose of the project is to provide basic information for :

— Regional forest policies and strategies ;
— Resolving cross-country environmental issues ;
— Modelling regional processes of change ;
— Assessing the nature and impact of large-scale events (*e.g.* the 1997 forest fires in Indonesia).

TREES also serves as a tool for continuous surveillance, the detection of deforestation and the location of hot spots. Vegetation maps of Africa and South America were presented as well as a global synthesis of tropical forest areas and of the changes which have occurred over the last two decades. Similar assessments were also made by FAO and IUCN. The

figures produced in these three instances vary markedly with regard to forest cover and rate of change. These differences reflect differences in methodology, in sources of information and in definition of forest. Reference was made to FAO's Forest Resources Information System (FORIS) which, for the period 1990-2000, estimates a change in cover of tropical forests of – 12.3 million ha per year, or 0.62 % yearly.

**E. Lambin & H. Geist**, Department of Geography, U.C.L. — *Causes and Pathways of Tropical Deforestation.*

Understanding the dynamics of land use and land cover is one of the key imperatives in global environmental change research. With regard to forest areas the question arises about the major human causes of change in different geographical and historical contexts. A frequency analysis was made of the occurrence of underlying factors and direct causes of deforestation as reported in 152 case studies. This analysis shows that tropical deforestation is driven by identifiable regional variations of synergetic cause/driver combinations in which economic factors, institutions, national policies and remote influences are prominent. Causes and drivers cannot be reduced to a single variable or to a few variables even. Too much emphasis was given in the past to population growth and shifting cultivation. It appears that shifting cultivation is often associated with timber logging and road construction as concomitant causes. Population growth is a main issue in 1.4 % of the cases only. The six broad patterns commonly associated with tropical deforestation are agricultural expansion, wood extraction and infrastructure extension at the proximate level, and economic policy and institutional, cultural, technological and demographic factors at the underlying level. The multiple factors intervening in tropical deforestation make it particularly difficult to develop generic and widely applicable policies aiming at controlling the process. As a result the development of a "universal" model of deforestation is probably out of reach. However, a collection of specific models, which represent particular interactions between a reduced set of dominant driving forces in a given geographic situation, should be feasible. It is recommended that future case studies, aimed at understanding the causes of tropical deforestation, should follow a standard protocol in order to allow for improved comparisons in the future.

The framework of the LUCC (Land-Use and Land-Cover Change) of the IGBP (International Geosphere-Biosphere Programme) proved to be a fruitful platform from which to proceed.

**P. Defourny**, Department of Environmental Sciences and Land-Use Planning, U.C.L. — *Contribution of Space Observation to Tropical Forest Monitoring.*

Remote sensing is a precious tool to identify and locate different variables of the land cover : static distribution patterns, vegetation index, surface temperature, radar backscattered signals, dynamic variables, interannual signal. These data can be recorded at different scales of observation at different times. A further contribution can be obtained from georeferenced field campaigns based on GPS inputs. Forest cover observations can be made at resolutions of 5 to 1,000 m, including forest inventories, forest-type discrimination and forest degradation. With its 25 years of experience the remote sensing technology has reached maturity with regard to its applications of space-observed tropical forest cover. Further developments are expected in the fields of microwave remote sensing and from the use of hyperspectral polarometric SAR sensors.

## Discussion

The workshop demonstrated that a vast amount of information on the global forest cover is already available. It was noted, however, that the information was provided from a variety of different sources and that results were not always concurrent. It was also remarked that this wealth of information has not been translated yet into concrete recommendations and made available in a form that is accessible to decision-makers. The question was raised if the information available had had an impact up to now on the protection and sustainable management of the world's forest cover. It was suggested that the monitoring activities should be pursued in order to ensure the preservation and validation of the acquisitions made up to now. A justification for the continuation of monitoring and inventerization should be obtained from the actual demand from governments for this kind of information. So far it is not clear whether data on forest cover and on deforestation are the subject of concrete requests from governments and if these data are used to design policies and strategies for future forest management.

In order to enhance the utilization of forest cover data an effort should be made to streamline the different methodologies used, to reach a consensus about the definition of forests, and to standardize measurements and nomenclature. It should be clarified in which way shifting

cultivation was accounted for when quantifying deforestation. A gap in information gathering is the lack of precise knowledge on the operations of private wood extracting companies. Their marketing studies are obviously driving the extent and location of their activities ; however, the results of these assessments are not readily available. The future efforts of monitoring the evolution of the tropical forest area will need to elevate from a research and academic level to interpretative forms which can be used for decision-making.

The impact of inventories on policies to address deforestation will be enhanced if they are accompanied by an analysis of the causes and mechanisms of direct and permanent conversion of forests to other land uses. Forest area change should be seen in the overall framework of national development, legislation, cultural policies and tradition.

Workshop II (17 September, 2002)

# Sustainable Management of the Tropical Forest

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# Sustainable Management of Tropical Forests. A Road Map for Effective Targeting

by

Yvan BIOT *

## 1. Introduction

Questions about the sustainable utilization of natural resources in tropical regions have caught the public eye ever since the 1970s, when famine caused by drought in the Sahel was ascribed to the over-utilization of rangelands. A series of reports on the "limits to growth" by the Club of Rome in 1972, the Brundtland Report in 1987 (World Commission for Environment and Development 1987) and the UN Conference on Environment and Development in Rio in 1992, helped put the notion of limited natural resources near the top of the global development agenda. One of the eight Millennium Goals, the global charter for development in the 21st century, is a direct call for decision-makers to "ensure environmental sustainability". The present paper addresses the issue of environmental sustainability for the case of forests in the tropics.

Tropical forests provide several important services to society : they are the main livelihood system for local communities, produce timber and other resources for the national economy, contribute towards biodiversity conservation and are a buffer against excessive global climatic change and an important link in regional hydrological cycles. Our main objective in this paper is to establish guidelines to manage this resource in such a way that its future existence is not threatened.

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Forest management has traditionally been restricted to the technical issues of managing cohorts or stands of trees. In a first section, we shall address the issue of how such cohorts of trees can be managed for timber production from natural regeneration, or "old-growth" forest. More specifically, we shall ask the question : is it technically possible to extract timber from these forests in a way that does not harm future timber production and does not affect the forest's biodiversity, global climate buffering capacity and protection of the hydrological cycle ? The second section will take a bird's eye view, and look at tropical forests' present state and trends. We shall see that, despite the technical feasibility of sustainable timber production, tropical forests are disappearing at an alarming rate. In a third section, we shall analyse the reasons for tropical forest destruction, and in the fourth section, present an alternative forest management model that looks beyond the traditional forest boundary, and includes important elements of basic land-use governance. The concluding section will briefly look at the likely future of tropical forests in the light of current land-use governance trends.

The arguments presented in this paper are those of a development professional, and not of a forest scientist. The main journey which will take the reader from issues of technical feasibility to those related to political economy and modern development practice is a reflection of the author's own progression as a development professional, more specifically of his attempts to deal with important obstacles in the pursuit of the promotion of sustainable and equitable resource utilization. The paper's main thesis is that efforts to promote sustainable forest management thus far have over-emphasized the technical aspects of managing cohorts of trees, and failed to grasp where the real problems are. The alternative forest model we propose can be used as a road map for more effective targeting of development interventions. An extended forest management toolkit is also presented.

## 2. Can Timber be Extracted from Natural Tropical Forests without Significantly Affecting the Forest's Capacity to Reproduce itself ?

In this first section, we look at whether it is technically feasible to extract timber from natural forests in a sustainable way. We first look at the on-site effects of common selective logging practices. We then briefly address some of the key off-site effects of timber extraction, and in a third sub-section, present ways in which timber extraction from natural forests can be improved through "reduced impact logging".

## 2.1. On-site Effects and Long-term Productive Potential

Recent studies in South America and South-East Asia indicate that "selective logging" from natural regeneration forests can indeed be done in a way which is both economically viable and environmentally friendly. The results of one such study from the Central Brazilian Amazon are summarized below.

### *2.1.1. BIONTE - INPA's Biomass and Nutrients Experiment*

In a field experiment conducted by researchers from Brazil's National Institute for Amazonian Research (INPA) from 1992 to 1997, BIONTE simulated a selective logging operation with a view to study its on-site ecological footprint. Six different logging treatments were considered, in a Randomized Complete Block Design (RCBD) with three replicates. Plots were harvested at different time intervals to allow researchers to measure simultaneously both short- and medium-term impacts from the logging. Field and laboratory measurements were made to characterize tree (biomass) growth and regeneration, as well as nutrient exports, the behaviour of the soil meso- and micro-fauna, including mycorrhizae, litter-fall and decomposition, soil organic matter, soil nutrients, hydrology and hydro-chemistry. Results were used to calibrate a stand class model which allowed the simulation of the likely reaction of the stand to various intensities of logging. The following highlight some of the project's results : 1. The stand class model calibrated with data from the experiment showed that a harvest of 8 trees/ha, with dbh > 50 cm can probably be sustained every 25 to 30 years (Biot *et al.* 1997a). The productive potential of forests thus harvested is of the order of 1 $m^3$/ha/year, *i.e.* about 25 to 30 $m^3$/ha for each harvest ; 2. Removing this number of stems converted up to 15 % of the area into skid trails, with severe soil compaction. An additional 10-15 % of the forest suffered total removal of canopy cover with little soil compaction. About 50 % of the forest suffered light canopy thinning while about 25 % of the forest remained unaffected (Biot *et al.* 1997b) ; 3. For each tree harvested from the BIONTE plots, twelve more trees were damaged, eight of which were in the 10-20 cm DBH class. This is half of the damage recorded for the Eastern Amazon (Verissimo *et al.* 1992), which was ascribed to a lesser vine cover in the research plots of the BIONTE experiment ; 4. It took the forest on average three years to recover a positive biomass accumulation (Higuchi *et al.* 1997b). Growth for the six years following this initial

reaction was about 5 m³/ha/year, of which 1 m³/ha/year represents net growth for the commercial species of commercial DBH alone. Mortality, which affected 1 % of the natural stand annually, went up to about 2 % after logging and remained higher for about eight years after logging ; recruitment stayed at 3.5 to 4 % after the initial reaction period. BIOT *et al.* (1997a) found significant negative relationships between recruitment and DBH growth on the one hand, and stem density on the other, which reflect increased availability of light through the canopy ; 5. LEAL FILHO (2000) found high numbers of pioneer seedlings established from the seed-bank immediately after logging, especially in those areas that had experienced most disturbance from the logging operation (clearings and skid trails). Climax species originated mainly from the seed-rain. Differences between degree of disturbance caused by selective logging tend to fade over time, and, while environmental factors dominate the regeneration of the forest in the early stages after logging, competition amongst seedlings explain the further evolution of the seedling cohorts. Most importantly, Leal Filho found that the intensity of disturbance in the selectively logged BIONTE forest plots did not represent an impediment to the regeneration of climax species ; 6. Nutrient exports for the first harvest of 8 stems/ha, equivalent to a volume of about 30 m³/ha, amounted to about 50 kg N, 700 g P, 12 kg K, 15 kg Ca and 10 kg Mg (FERRAZ *et al.* 1997). When compared to the amounts replaced by rainfall and decomposing organic matter during the forest's recovery period, these exports are found to be relatively low for nitrogen and phosphorus, but high for calcium, magnesium and potassium ; 7. The impact of logging on soil water and temperature characteristics has been reported by FERREIRA *et al.* (2002). As expected, only the skid trails and clearings displayed a temporary impact, with the impact in the clearings restricted to soil temperature during the first months after logging ; 8. Soil moisture and dissolved nutrient contents were higher in the clearings and skid trails during the first five weeks after logging (MELLO-IVO *et al.* 1996), conditions which are highly propitious for the rapid growth of the pioneer species that cover the soil almost immediately after logging ; 9. The same was true for soil nutrient contents : a slight increase in available P in the clearings during the first year after logging (LUIZAO, R. *et al.* 1997), higher amounts of Ca and Mg in clearings (and especially in the clearing edges where large amounts of woody litter covered the soil) which remain somewhat higher than in the less disturbed parts of the forest up to at least seven years after logging (DIEHL & LUIZAO 1997). No changes were observed in soil C and N (CAMPISTA-FERREIRA *et al.* 1997) ; 10. A

small decrease in mycorrhizal infectivity was observed immediately after logging which had no impact on the growth rate of test species (LUIZAO, R. *et al.* 1997). The soil meso-fauna was reduced immediately after logging, but recovered to levels higher than recorded pre-logging, until three months after logging. The medium-term effect revealed itself in intense fluctuations of meso-fauna populations (ANTONY 1997) ; 11. Initial measurements of the effect of logging on fauna and flora diversity showed a slight increase in bird activity for the first year after logging (GUILHERME & CINTRA 1997) ; somewhat altered species composition of lizards and frogs in the clearings during the dry season immediately following logging (SUAREZ *et al.* 1997) and a small change in species composition of the herbaceous layer during the first year after logging (COSTA 1997) ; 12. Simulation results using BIONTE's stand class model linked to carbon and nitrogen balance subroutines (BIOT *et al.* 1997a) indicate that : (a) logging under the above-mentioned sustainable harvest conditions leads to a forest which has a stand class distribution with less large trees, a slightly lesser amount of total biomass, higher amounts of woody litter, a slightly lesser amount of nitrogen in the biomass, soil and soil solution and a slightly lesser amount of soil C ; (b) C-accumulation in the re-growth after logging results in a net carbon fixation, even after taking into account increased C mineralization and litter decomposition as measured in the plots of the BIONTE experiment ; (c) restricting harvesting to the few species that were commercialized at the time of the experiment may result in a gradual erosion of the forest's biodiversity. Further details on BIONTE can be found in the project's final report by HIGUCHI *et al.* (1997a)

## 2.2. INDIRECT AND OFF-SITE EFFECTS

### *2.2.1. Fire*

While the results of BIONTE's research tend to indicate that the overall *on-site* ecological impacts from selective logging are limited and short-lived, increased flammability has been shown to represent a serious threat to the long-term viability of this forest utilization system. A survey conducted in the Amazonian "Arc of Deforestation" (NEPSTAD *et al.* 1999) found that 20 % of the total area destroyed by fire in 1994-95 consisted of standing forest, adjacent to areas burned for forest conversion (13 % of total area burned) or agricultural purposes (67 % of total area burned). These forest fires can kill from 10 to 80 % of the forest's aboveground

biomass, and further increases flammability. The effect on biodiversity is as yet unknown. Fires are particularly destructive during *El Niño* years, when rainfall is significantly lower than average. Annual financial losses due to fire in timber production forests in the Brazilian Amazon range from US$ 1-13 million for lost timber, and from US$ 290-4,700 million for release of $CO_2$ (Diaz *et al.* 2002).

### *2.2.2. Catchment Hydrology*

An additional concern is the impact on stream hydrology from the logging operation's network of roads and log ponds. Research on the latter, however, is largely inconclusive for the case of large hydrological basins (Calder *et al.* 2003), and direct links between logging and flash floods such as those which caused the tragic death recently of more than 120 local people and foreign tourists in North Sumatra (Bahorok, 2 November, 2003) are notoriously hard to establish.

## 2.3. Reduced Impact Logging (RIL)

Reduced Impact Logging (RIL) techniques are advocated by a variety of non-governmental organizations (NGOs) to further reduce the direct and indirect environmental impact from selective logging.

RIL commonly involves four steps (Higman *et al.* 1999) : *(i)* harvest planning, *(ii)* tree marking and felling, *(iii)* extraction and *(iv)* post-harvest operations. In Brazil, an important pre-harvest operation is added : vine cutting (Amaral *et al.* 1998). The aim of harvest planning is to identify the areas to be felled, and those to be protected, and to produce a "stock map" which contains information on the trees to be harvested, the direction to fell them and the preferred routes to export the harvest. Stock maps are produced from "Forest Inventories" (Scolforo 1993). Choosing the trees to fell depends on (a) the harvest level desired, (b) which species are protected against felling (such as *Mahogany* in Brazil, and *Ramin* in Indonesia, both species protected under the Convention on the International Trade of Endangered Species CITES, or other species essential to the livelihood systems of local people), (c) distance to rivers and (d) the maintenance of a minimum desired density of seed trees. Once stock maps are prepared, the trees to be extracted are marked in the field. Additional criteria are used by experienced foresters to make adjustments to the choices made on the initial stock maps, such as proximity to other trees, defects in the stem and crown, and likely direction of

fall. The extraction roads, skid trails and log ponds are then established, using specialized equipment (skidders, winches,...) to minimize damage to both soil and the residual stand. Simple post-harvest interventions can improve the quality and pace of forest rehabilitation after logging. Ripping and replanting of log ponds and skid trails, and simple runoff-diversion works can significantly reduce the potential for soil erosion. Permanent Sample Plots (PSP) are established to follow regeneration and determined when a subsequent harvest is possible. Protecting the forest against conversion to other uses is a crucial management concern. Other silvicultural interventions such as occasional thinning of non-commercial species, enrichment planting and controlling species distribution in the seedling population have at various times been recommended, and form part of the national forest management system in Indonesia ; however, the usefulness of such interventions is hotly contested amongst foresters. When conducted using the above guidelines, Reduced Impact Logging can result in a 50 % reduction in damage to the residual stand and smaller-sized clearings (AMARAL *et al.* 1998). Increased benefits from greater extraction efficiency, both in terms of $m^3$ wood harvested and more efficient use of machinery and labour, are claimed to offset the cost of the initial pre-harvest planning. HIGMAN *et al.* (1999) quoted similar findings by BRIJNZEEL & CRITCHLEY (1994) for an upland forest in Suriname, and PUTZ & PINARD (1996) for a forest in Sarawak, Malaysia. AMARAL *et al.* (1998) predict a 68 % increase in the size of the second harvest because of a lesser damage to the stand. BIOT *et al.* (1997a) are more cautious, considering the possible reduction in re-growth caused by reduced light penetration through the protected canopy of the RIL forests.

## 3. Are Tropical Forests Managed Sustainably ?

Having the technology to extract timber from natural forests with minimal impacts on the environment does not mean that forests are managed sustainably. Figure 1, which shows the pace of forest cover reduction as measured from satellite imagery in Brazil and Indonesia, tends to indicate that we are indeed NOT able to manage forests sustainably. Particularly worrying in this respect are the latest estimates in forest cover reduction in these two countries which show that, despite substantial international efforts, the rate of deforestation is accelerating : according to Brazil's National Space Agency (INPE), deforestation in Brazil for the 2001/2002 season measured 25,550 $km^2$, after a 6-year "lull" during which deforestation rates were usually less than 18,000 $km^2$.

The latest reliable data on annual deforestation in Indonesia amounts to 17,000 km² for the 1985-97 period (HOLMES 2002) ; estimates for the last 5 years range between 20,000 (FWI / GFW 2001) and a staggering 38,000 km² (PURNAMA 2003).

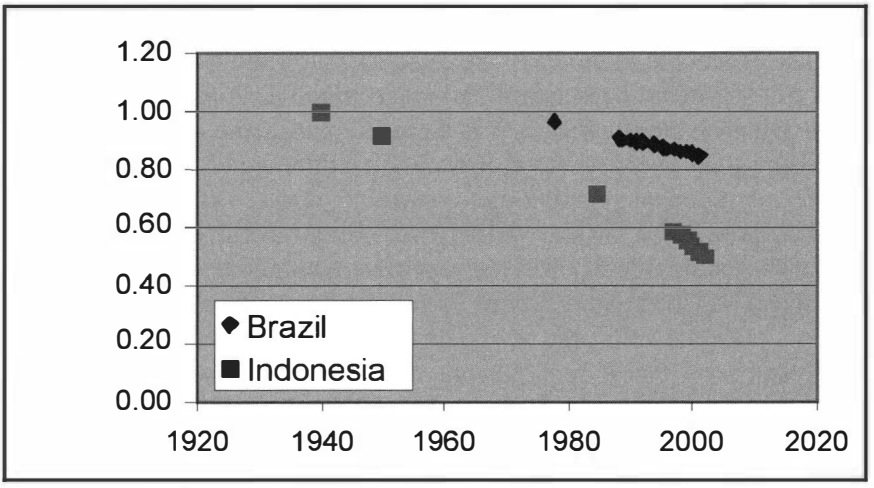


Fig. 1. — Proportion of original forest cover left (1940 = 1).

## 4. Why Are Tropical Forests Disappearing?

To find out what really happens to tropical forests today, we look first inside and then outside those forest management units that are being used for timber extraction. The concluding sub-section tries to derive an overall political-economic picture of what happens in tropical forests as a whole.

### 4.1. TIMBER PRODUCTION

The extent to which forests are being managed within the confines of the law, and the proportion of tropical hardwood production that is "certified" as having been produced "sustainably", measure what really happens within those areas of forest that are managed for tropical hardwood production.

#### *4.1.1. Legal Timber Production*

National legislation on forest management such as Indonesia's Selective Cutting and Planting system (TPTI) and Brazil's Código

Florestal (Ministério do Meio Ambiente 2002) incorporate basic concepts of sustainability as advocated by the International Timber Trade Organisation (ITTO 1992, 1998) (PRABHU *et al.* 1998). These concepts build on some of the RIL techniques mentioned above, and are translated into a set of criteria to guarantee the forest's ecosystem, health and condition, flow of forest products, biological diversity, soil and water conservation and economic, social and cultural factors.

Adhering to national legislation goes some way towards guaranteeing sustainable timber production, and promoting legal timber production has been the subject of renewed action by international agencies. Measuring the extent of legal compliance, therefore, could be regarded as a first approximation of the industry's adherence to basic principles of sustainability.

Data compiled recently by COLCHESTER *et al.* (2003b) (tab. 1) show clearly that legal timber production is still the exception rather than the rule.

**Table 1**

Illegal logging in selected tropical countries (after COLCHESTER *et al.* 2003)

| | | |
|---|---|---|
| Bolivia | 80-90 % | CONTRERAS-HERMOSILLA 2002 |
| Brazil | 80 % | CONTRERAS-HERMOSILLA 2002 |
| Cambodia | 94 % | CONTRERAS-HERMOSILLA 2002 |
| Cameroon | "over half of all logging licences" | CONTRERAS-HERMOSILLA 2002 |
| Colombia | 42 % | CONTRERAS-HERMOSILLA 2002 |
| Honduras | 75-80 % hardwood, 30-50 % softwood | RICHARDS *et al.* 2003 |
| Indonesia | 55-75 % | TACCONI *et al.* 2002 |
| Nicaragua | 50 % hardwood, 40-45 % softwood | RICHARDS *et al.* 2003 |
| Peru | "at least 80 %" | CHIRINOS & RUIZ 2003 |
| Philippines | 46 % of domestic consumption | CONTRERAS-HERMOSILLA 2002 |

### *4.1.2. Certified Timber Production*

Certification of timber products by market instruments under the auspices of the Forest Stewardship Council (FSC), an international non-governmental body set up in 1993 by international civil society organizations concerned about the fate of the world's forests, goes beyond what is required by national legislation. Currently, companies which desire certification to the standards set by the FSC need comply

with a set of requirements organized around 10 basic principles (HIGMAN *et al.* 2000).

Principle 1 : Compliance with the laws and FSC principles ; Principle 2 : Tenure and use rights and responsibilities ; Principle 3 : Indigenous people's rights ; Principle 4 : Community relations and workers' rights ; Principle 5 : Benefits from the forests ; Principle 6 : Environmental impacts ; Principle 7 : Management Plans Principle ; Principle 8 : Monitoring and assessment ; Principle 9 : Maintenance of High Conservation Value Forests Principle ; Principle 10 : Plantations.

Despite concerted efforts by several non-governmental organizations, including some with partial funding from large timber consumer groups, the extent of forest product certification in the tropics is minimal. In 2000, the World Wildlife Fund for Nature (WWF) quoted that, worldwide, 18 million ha of forests are certified. Most of this area is in temperate regions, and a significant proportion involves planted forests. The total area of tropical forest under natural regeneration management with FSC validated certification is very low : available data indicate that four companies covering an area of about 275,000 ha of forest in the States of Amazonas and Pará, and producing a total of 137,000 $m^3$ of wood have obtained, or are close to obtaining, FSC certification in the Brazilian Amazon. In Indonesia, only one concession currently holds a FSC validated certificate for timber production from natural regeneration forests, *i.e.* Diamond Raya in Riau, Sumatra, covering an area of about 90,000 ha.

### 4.2. BEYOND TIMBER PRODUCTION

Natural forests are not used for timber production alone. They also provide resources for a variety of other land users, who often compete with each other over access. They are commonly referred to as the forest's primary "stakeholders". Tables 2, 3 and 4 list the main small- and large-scale land users in Brazil and Indonesia. The text in the "comments" column amply illustrates the pressure exerted by large-scale migrant agriculture, commodity production plantation schemes and conservation areas that are gradually taking over forests from traditional small-scale agro-extractivists and selective logging operators.

**Table 2**

Main types of forest-dependent communities in Brazil and Indonesia

| Economic Focus | Brazil | Indonesia | Comments |
|---|---|---|---|
| Production, local | — Indigenous people<br>— "Ribeirinhos" | — Indigenous people | Land users in this category typically evolved a complex land-use system which combines slash and burn agriculture with low intensity extractivism of forest commodities. The latter are sold to local traders who often pay minimal prices for the goods they obtain, while selling products from the outside at inflated rates. In Brazil, a large amount of timber which reaches processing plants originates from this market chain. In both countries, male household members increasingly look for alternative employment elsewhere, and send remittances to make ends meet. |
| Production, local and national | — Independent migrants<br>— INCRA settlers | — Independent migrants<br>— TRANSMIGRASI settlers | Originating from other regions, independent and government-assisted settlers commonly attempt to develop intensive agricultural systems on small- to medium-size plots of land which are rapidly cleared of all tree cover. Lured by promises of government-assisted, modern agricultural support systems, settlers often find themselves isolated, on poor land, in conflict with traditional users of the land, and largely abandoned by government agencies. In Brazil, there is a tendency to convert such land gradually into pasture, part of which is sold off to large-scale producers before setting out again on the migration trail. In Indonesia, large numbers of settlers from Java and other densely populated islands such as Madura have been brought in as labour in logging concessions and oil-palm plantations. |

**Table 3**

Main large-scale land users in the forests of Brazil and Indonesia — commodity production

| Economic Focus | Brazil | Indonesia | Comments |
|---|---|---|---|
| Production, international and national | — Loggers<br>— Cattle ranches<br>— Plantations | — Loggers<br>— Plantations<br>— Open-cast mining | Logging by large-scale operators in both countries, while licensed in very different ways, is best described as "timber mining". Basic legal, let alone sustainable production criteria, are rarely adhered to. As a result, land which has been logged once frequently has insufficient timber for a productive second cut, is prone to fire and is not well protected against invasion by migrant settlers. Depending on access rights, this land evolves into extensive areas of secondary tree or grass vegetation (*belukar* and *alang-alang* respectively in Indonesia), or are converted into alternative land-use types, such as cattle production ranches (Brazil) and oil-palm plantations (Indonesia). Plantations in Indonesia include mainly oil palm, with some rubber and cocoa. Extensive plantations of such commodities have been largely unsuccessful in the Amazon, where cattle ranches dominate. The area of cattle ranches in the Amazon expanded exponentially during the 1980s when settlers were given financial incentives from the Federal government. They are usually abandoned after about seven years. The regeneration potential of such abandoned land is largely unknown. The latest conversion rate for forests in the Brazilian Amazon is ascribed to renewed expansion of cattle ranching (David Kaimowitz, pers. comm., 2004). Planting fast-growing timber species for pulp and paper is also expanding rapidly in both countries. In Indonesia, large areas of forest that were originally used by local communities have been set aside for large-scale timber production and / or plantation, with the result of *de facto* criminalizing traditional forest occupation in such areas. Large-scale open-cast mining, especially of coal in Kalimantan, is a growing threat to Indonesian forests. |

**Table 4**

Main large-scale land users in the forests of Brazil and Indonesia — conservation

| Economic Focus | Brazil | Indonesia | Comments |
|---|---|---|---|
| Nature conservation, national and international | — Nature reserves | — Nature reserves<br>— Watershed protection areas | In both countries, large areas of land have been set aside to provide for a variety of environmental services, including : biodiversity conservation, watershed protection and, increasingly, carbon sequestration. Protecting conservation and protection areas against poaching and invasion is difficult because of their remoteness and extent, as well as a lack of adequate financial resources. In Indonesia, the situation is particularly complicated because the establishment of conservation areas has often led to the forceful removal of local communities which frequently found themselves unable to find alternative sources of livelihood, and resort to "illegally" harvesting products from the land which was traditionally theirs. |

### 4.3. A Tragedy of the (Unmanaged) Commons

The tables above illustrate the extent of the problem : *(i)* timber extractors do not adhere to the law, let alone to more sophisticated criteria of sustainable timber production ; *(ii)* natural forests are gradually but irreversibly being converted into a variety of new, often large-scale, commodity production systems ; *(iii)* large areas of natural tropical forest that have been set aside for watershed and/or biodiversity conservation are threatened by poachers. Timber production and conservation forests are increasingly difficult to protect against the encroaching interests of other stakeholders, including the original local communities, poor agricultural settlers and large-scale commodity producers.

The situation in Brazil and Indonesia is fairly typical of what happens in the forests of other tropical countries. Figure 2, after Nugroho (1999), summarizes this from the perspective of "who is in charge".

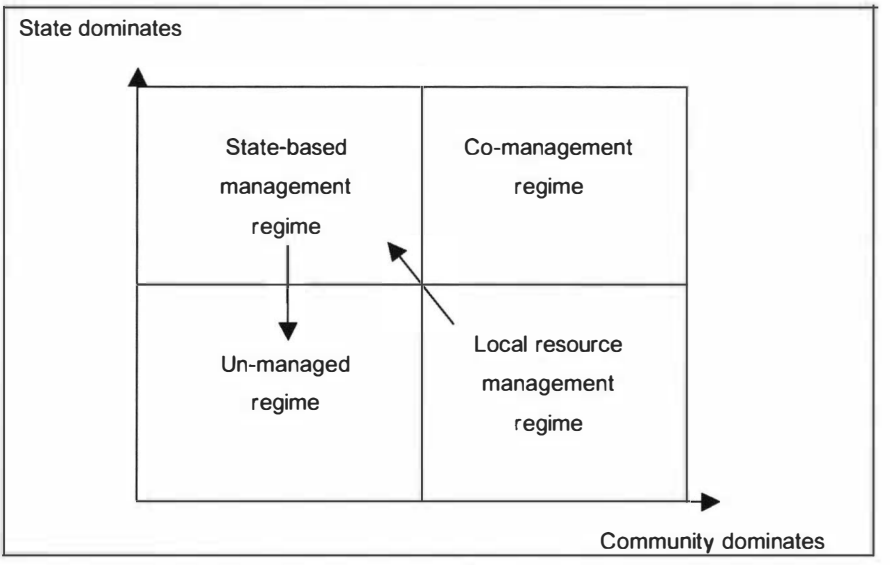


Fig. 2. — Forest management regimes as defined by the degree of state / community involvement.

Key to Nugroho's model is the understanding of the importance of the modern State as it appears, and gradually but definitely comes to dominate forest management to fuel economic growth. In staking its claim, the modern state has wrested away management control over the

forests from local communities, and awarded user rights to large-scale economic agents and agricultural settlers from other regions. Thus, the dominant forest management regime shifted from a "community dominant" phase to a "state dominant" phase. This shift is illustrated by the arrow from the bottom right, to the top left quadrant in figure 2.

Poor law enforcement in most tropical countries indicates that the State has failed in its role of resource manager. With neither community, nor the State effectively managing forests, a true *Tragedy of the Unmanaged Commons* (HARDIN 1968) has ensued. This move is illustrated by the second arrow, pointing from the top to the bottom left quadrant in figure 2. Two examples from Brazil and Indonesia illustrate this evolution.

### *4.3.1. The State Takes and Loses Control of Forests in Indonesia*

The State first took control of parts of Indonesia's forests in the 17th century when Dutch traders reserved tracts of forest in East Java to secure timber supplies for the maintenance of their navy (SARAGIH 2001). This eventually gave rise to the nationalization of the Forest Estate in 1870. The Basic Forestry Law of 1967 transferred management responsibility over the National Forest Estate to the Department of Forestry which has kept this responsibility to date. Indonesia's National Forest Estate is subdivided into the following categories:

— Production and limited production forests : 58 million ha (48 %);
— Watershed protection forests : 34 million ha (28 %);
— Natural reserves : 20 million ha (17 %);
— Conversion forests : 8 million ha (7 %).

Production, limited production and conversion forests were put out to tender to large-scale operators, and local communities lost *de facto* access rights over large areas of land that used to support their livelihood systems. Thirty-five years of State-dominated forest regime has left 42 % of the forest under primary condition, and 24 % with almost no residual tree cover at all. The data for the categories listed above are as follows : production and limited production forests : 34 % primary and 34 % without forest cover ; watershed protection forests : 54 % primary and 15 % without forest cover ; natural reserves : 61 % primary and 22 % without forest cover (Department of Forestry, quoted in World Bank 2003).

Two attempts at sharing management responsibility with local communities (1970s and 1990s) and local government (2001) allowing

Regents to issue small-scale concession rights for timber production and/or forest conversion have failed so far to reduce the pace of forest destruction. It remains to be seen whether the present administration's attempts at sharing forest management responsibilities with local communities under the new National Social Forestry Programme of 2003 will succeed where others have failed so far to properly motivate local community. Today's situation is as worrying as ever, with both central and local governments wrestling for authority over the country's forests in a seemingly unending power struggle. And while this proceeds, local communities and responsible concessionaires alike despair about what will become of this vital resource while the system is being depleted by large numbers of free riders.

*4.3.2. The Fate of the* Babaçu *Forests in Maranhão, Brazil* (after MESQUITE 1996)

The State of Maranhão straddles three important ecosystems : the humid tropical Amazon Forest in the north and north-east ; the semi-arid Sertão, a dry bush savanna-like vegetation, in the north-west, and the sub-humid Cerrado, a tree savanna-like vegetation in the centre, south and south-west. The transition zone between the Amazon Forest and the Cerrado consists of an "Open Canopy Forest" which, on repeated slash and burn, evolves into a *Babaçu* (*Attalea Speciosa* ; *Obrignya phalerata*) palm forest. Originally inhabited by Amerindian populations, the coastal area was explored by Portuguese settlers from the mid-16th century onwards. The French built the city of São Luís, the present State capital in the beginning of the 17th century, but were soon evicted by the Portuguese. Agricultural migrants from Europe first settled along the State's main rivers, especially in the Itapecurú and Mearim river basins. After subjugating the indigenous populations, they converted the rich alluvial soils into large-scale sugar cane plantations, which were worked with slave labour from Africa. The sugar cane economy went into decline when the Dutch established their sugar industry to the Caribbean, and the *latifundiários* shifted to cotton. Slavery was abolished in 1888, and many of the descendants from the original African slaves were evicted from the plantations. To survive, they either joined the few existing settlements of runaway slaves and poor Portuguese peasants, or set up new settlements in the surrounding uplands, then largely covered by open-canopy forest. New waves of poor migrants arrived in the region in the 1920s and 40s, expulsed from the dry north-east where sugar cane plantations expanded

and converted into mechanical operation. Population increased and the open-canopy forest was eventually all but completely converted into *Babaçu*, except for the tops of the low hills in which remnants of natural forest were preserved. Oil extracted from the kernel of the *Babaçu* fruit is suitable for soap production, and several medium- to large-scale oil extraction and soap factories, including some with Belgian capital, were established. Thus, a typical mixed subsistence/market-based, family-operated agricultural system evolved which still represents the main livelihood system of the majority of the rural poor, and is known in Brazil as *agricultura familiar*. The main cash crops at that time consisted of rice and *Babaçu*, and the long fallow periods used to rejuvenate the soil guaranteed a sustainable system. The State officially intervened in this system in 1969, when the then State Governor, and later President of Brazil, José Sarney enacted a new land law which gave formal land property titles to those who could prove that they had occupied the land for a minimum length of time. The illiterate local farmers were not properly informed about the existence and modalities for implementation of this law, and property of the land was gradually transferred to rich settlers from the south who fenced off large parts of the (already largely settled) *Babaçu* forests of Maranhão. Original settlers who opposed this process were evicted, or shot by hired gunmen (*pistoleiros*) who operate to this day in pursuit of farmer-union leaders and reform minded priests. Thus, the *Babaçu* forests, which were originally farmed successfully by large amounts of small-scale settlers for two generations, were gradually destroyed and transformed into rangeland for cattle production after the State intervened in their management. Some of the settlers who had opted for resettlement in the closed canopy forests to the east of the State, and beyond into the States of Pará and Tocantins, found themselves victim to the same process of eviction when the Amazon region was opened up for settlement by large-scale cattle production units through Federal law enacted by the military regime in 1980. Today, the majority of migrant settlers in the States of Pará, Tocantins, and as far as Roraima, originate from Maranhão from where they were evicted after the unfortunate intervention of the State governor in 1969. The unrelenting trend of deforestation shown in figure 1 indicates how, for the case of the *Babaçu* forests of Maranhão as well as for the forests of the wider Amazon Basin, once it attempts to extract resources to accelerate the forest (land)'s contribution to the national economy by bringing in large-scale operators, the State rapidly loses control over what happens in the forests.

## 5. The Way Forward

This paper started with a description of the potential of sustainable timber harvesting from natural forest in the tropics. In the previous sections we concluded that, while possible within the confines of (mostly donor funded) experiments, environmentally and socially friendly management is rarely achieved in reality. We looked beyond the confines of the Forest Management Unit to get a full picture of the extent of the problem. The forest model used to simulate the reaction of the Forest Management Unit to different management interventions and suddenly becomes all but redundant as it is not able to simulate the behaviour of the humans who run the model. We conclude along with NUGROHO (2003) that managing forests in the tropics in the 21st century is about managing forest *land,* and that this relies as much on managing *people* as it does on managing *trees.*

In this section, we look at some concepts that we have found useful in trying to move on from today's rather dismal snapshot of the state of the tropical forests in Brazil and Indonesia. We start with an alternative (conceptual) forest *land* model which we aim to use as a road map for the new forest manager. We then use the map to describe where we are today, and where we might want to go. We also give some ideas about which buttons to press, and what our new toolkit might look like.

### 5.1. AN ALTERNATIVE FOREST MODEL

Consistent with our findings above that the fate of the forest depends on what happens beyond the limits of the Forest Management Unit, our alternative forest model (fig. 3) incorporates the "bits outside the box". The model shows how the fate of the Forest Management Unit depends on its relationship with other land-use types. This, in turn, depends on policies and institutions that govern land use. The latter are influenced by a number of processes that operate beyond the national boundaries. This model of the forestry ecosystem is consistent with the "causal chain of explanation" introduced by BLAIKIE (1985) to explain the equally disappointing achievements of soil conservation worldwide.

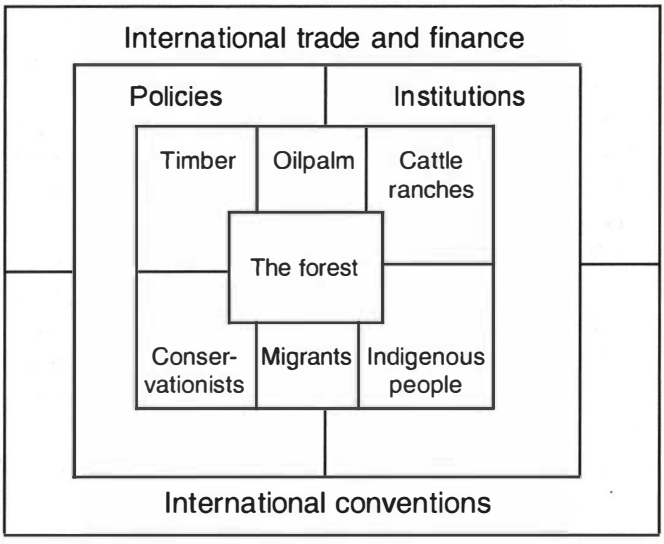


Fig. 3. — An alternative model of the forest system.

## 5.2. Where are we Today ?

Tropical forests are in crisis, and this crisis can be described in terms that are reminiscent of Hardin's "Tragedy of the (unmanaged) commons". Individuals are not compelled anymore to do what is good or even necessary for the long-term survival of the system. Unlike in a "managed" commons such as operated before the intervention of the modern State, in an "unmanaged" commons individual investments to maintain the long-term productivity of the environment do not afford a concomitant reward. In the case of the unmanaged forest, the decision by an individual not to harvest a tree to guarantee continued seed production, hence the maintenance of biodiversity, will almost certainly result in the tree being harvested by his/her (distant) neighbour. This knowledge then prompts the individual to harvest *ditto* tree anyway, often even before "maturity", to avoid somebody else laying his/her hands on it. This behaviour eventually leads to accelerated resource depletion / degradation such as is currently observed in Indonesia and Russia.

The role of the official forestry administration in creating the conditions for this situation, as well as its unequal treatment of different segments of society and its blatant collusion with elements from the emergent private sector, have severely affected the State's ability to

effectively reverse this trend. After decennia of seeing their resources being plundered by others, with help from government officials, local communities have gradually lost trust in the government. Local communities in the tropics are increasingly rejecting their social contract with the State and, where they can, have taken matters into their own hands.

In some cases, this has led to attempts to revitalize ancestral forest management practices, such as in Lombok, Kalimantan, Sulawesi and Papua, Indonesia, where local communities manage and police their forests and try both local and non-local offenders in local courts. In many cases, though, individual entrepreneurs exploit the destruction of the original social fabric of local communities, as well as the absence of fear of the State's ability to police the forests, to lay their hands quickly on valuable timber before others do, as was demonstrated for the case of local government-issued timber harvesting licenses in Indonesia (Casson & Obidzinski 2002).

Unmanaged commons are places of conflicts. Conflicts both amongst and inside local communities, between local communities and logging concessions or plantations, between local communities, large-scale operators and the State, between local government and central government. The case of the local communities living at the edge of the protection forests in Sikka Regency, Flores island, is a particularly poignant example as it involves an intricate mesh of different conflicts woven into the very fabric of local society.

In the subsections below, an example of community-led law enforcement from Kalimantan, Indonesia, and another one on a multilayer conflict in Flores, Indonesia, illustrate some of the current opportunities and threats facing tropical forests today.

### *5.2.1. Law Enforcement by Local Community in Pendaun, West Kalimantan*

The extent of *illegal logging* (see tab. 1) bears witness to the ineffectiveness of state control over forests. This situation is particularly acute in Indonesia, where the government and the international community consider it the most important problem facing sustainable forest management today. In those areas where forests represent an important component of the livelihood system, such as in many islands beyond Java, local communities bear the brunt of such illegal forest destruction. In some such areas, ancestral legal systems are resuscitated to help manage and police the forest. In West Kalimantan, the traditional

*Dayak* community in the village of Pendaun (Ketapang Regency) have re-introduced the traditional concept and regulation of *Tanah Colap Torun Pusaka* (The Cold Lands of the Sacred Forest) to define and police areas of forest that are considered to be particularly threatened by illegal logging. Within the confines of that area, traditional law applies to anyone violating the sanctity of the place, whether the person is from outside, or within the Pendaun community. The origin of the *Tanah Colap* concept is linked to the past when *ngayau* (battles between rival groups in which head-hunting was practised) were common. The *Tanah Colap* were then conflict-free zones where warring was prohibited. They acted as a traditional brake on interethnic conflicts, ensuring that tensions among communities could not spread. As times have changed, and modern temptations as well as sheer necessity have led some *Dayaks* to turn from head-hunting to illegal logging, the function of the *Tanah Colap* has also evolved from one of regulating war to protecting forest resources. *Tanah Colap* areas are demarcated by a trail and traditional signposts. The trails are patrolled at regular intervals by groups of villagers and transgressors are brought to justice under traditional law. Punishments vary from fines to the financing of public acts of contrition that are powerful disincentives for infringement of the law. So far, the system has been implemented in three forests, and seems to have been accepted by the local government authorities.

### *5.2.2. Multilayer Conflicts around the Watershed Protection Forests in Sikka Regency, Flores, Indonesia*

A good vegetative cover of the upper slopes of water catchments is a prerequisite for the protection of lower lying land from water shortages in the dry seasons, and flooding in the rainy season. Forests have long been considered a suitable vegetation type to achieve this objective, hence much sloping land has been classified as *hutan lindung*, or "protection forests", a land-use type whose utilization is strictly controlled by government regulation. In Indonesia, the first areas to be protected as *hutan lindung* were defined by the Dutch, and mapped in the 1930s. In the second half of the 1980s, the extent of the *hutan lindung* was increased in many areas, including the island of Flores, east of Bali. This resulted in the forced displacement of villages downhill, and the loss of land available for agroforestry. In one such area visited by the author in 2002, the new village was sandwiched between the newly defined *hutan lindung* and a forest concession issued to the local parish, with the

result that only 4 ha of land remained legally accessible for farming. Illegal harvesting of forest products from the concession area, and illegal farming in the *hutan lindung* were the only options open to those villagers who did not find alternative sources of income, which resulted in frequent arrests and temporary imprisonment. *Hutan Lindung Egon-Ilimedo*, in Sikka Regency, is a particularly difficult case. In this forest area, two communities, the *Tara Gahar Tajo Mosan* and the *Koker Mune Blutuk* claim descendency from the original tribe, *Suku Wodon,* which inhabited the upper slopes that fell within the extension of the *hutan lindung* in 1984. Both communities are in conflict with the government authorities as they revendicate a return to the 1932 limits of *hutan lindung*. The conflict has been expressed through demonstrations and destruction of government forest plantations. Both communities are also in conflict with each other on the issue of how to resolve the impasse with government. One, the *Tara Gahar Tajo Mosan* insist on a return to traditional land ownership, or *tana puan*, while the other, the *Koker Mune Blutuk* are prepared to accept the new limits of the *hutan lindung,* on condition that they are allowed usufruct rights under the government's *HKM* (People Forests) scheme. The conflict is further complicated by the former village's support by a local NGO, and the latter's by local government. Conflicts such as this one are, unfortunately, rife in Indonesia, and are the main cause of violent interethnic conflicts such as in Kalimantan and Maluku, where later migrations further complicate the issue. Intervention by capable independent conflict mediators is often necessary, if risky, to bring such cases to the point where co-management by the various parties becomes possible. The unfortunate connivance of government authorities with one or another party in the past has severely affected the State's capacity to moderate such conflicts, and voluntary organizations frequently lack the professional mediation skills to negotiate the pitfalls of conflict mediation. Capacity building in conflict mediation is an obvious opportunity for donor projects ; however, the results of such work can lead in a direction which threatens the case of one or the other side, which can put donors in a tight spot with either civil society or government.

### 5.3. Where to ?

While acknowledging that the description in the previous section is overly simplified, we contend that most present tropical forest management regimes and their evolutionary trends can be situated somewhere

within the trajectory traced by NUGROHO (1999) in figure 2. Most tropical forest systems are affected by the kinds of dynamics that lead forests towards, through or, in some isolated cases, somewhat beyond the condition of an unmanaged commons.

The main condition to be met to reverse the tragedy of this unmanaged commons is to ensure that the individuals, whose actions affect the resource, get rewarded for investing in its long-term maintenance. This requires the negotiation of a new social contract with the State, and may involve an initial stage of negotiating local contracts with competing neighbours to minimize the extent of conflict.

*Managing tropical forests today is largely a question of managing conflict.*

Nugroho's map of the main forest management systems combined with lessons learnt from as yet isolated initiatives in Brazil and Indonesia give a clue as to where we might want to head, *i.e.* towards joint management by the State and Local Community (fig. 4). This conclusion is based on the fact that, as time has moved on since forests were opened up for exploitation by large-scale national and international market operators, local communities have seen their initial social capital eroded, and new, competing stakeholders have appeared in the forests, creating new dependencies and relations that need mediation.

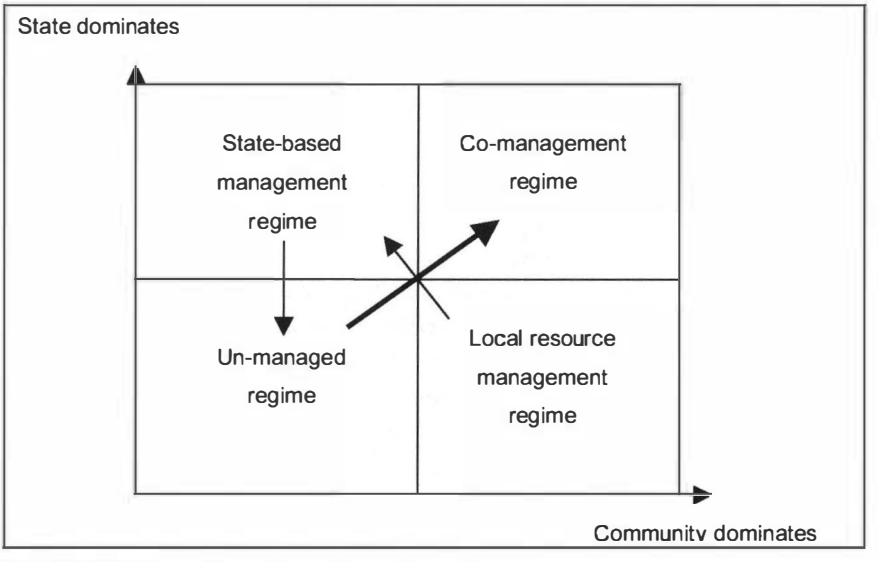


Fig. 4. — Where to ?

The case of the management of the Mirador Nature Reserve in Maranhão, Brazil, illustrates the concept. Numerous other local initiatives all point in the same direction of co-management by the State (Enterprises) and Local Communities, such as in the Mamirauá Nature Reserve, Amazonas, Brazil, and the Community-based Forests Management system currently promoted by Perum Perhutani, the State-owned company responsible for forest management in Java, Indonesia.

*5.3.1. Local People, the Private Sector and the State Co-manage the Mirador Nature Reserve in Brazil*

The Mirador Nature Reserve covers an area of about 500,000 ha of *Cerrado*, a tree-savannah-like formation, in the south of the State of Maranhão. The typical table landscape exhibits an ancient plantation surface with deep clayey latosols and occasional patches of laterite, at about 70 to 80 m above a gently sloping, mostly sandy pediment which drains into permanent streams enclosed in dense gallery forests. Poor agricultural migrants from the Brazilian North-East settled in the area in the first half of the 20th century. Their livelihood system is characterized as "agro-extractivist", as it combines mixed annual crop production through "slash and burn" in the gallery forests with fruit collection and hunting from the pediments and old plantation surface. The area also represents important dry season grazing for cattle from outside the Park. An intricate web of dependent social relations has evolved between the mainly agricultural settlers inhabiting the Park area and the cattle producers from outside the Reserve. The main source of cash consists of the sale of fruit and occasional bushmeat, herding and agricultural state pensions. The main threats to the area are : fire, (mainly sports-) hunting by organized gangs from across the State and invasion by soybean farmers, who have cast their eye on the extensive old plantation surfaces which are ideally suited to this crop. The State converted the area into a nature reserve in 1980, but never committed sufficient financial resources to legally demarcate it, let alone resettle the local population or compensate the cattle producers for the loss of their dry-season grazing. When asked to identify the single most significant date in their life history, local farmers consistently point to the creation of the Park in 1980, adding that this had ended a long period of uncertainty over resource access which was threatened by the expansion of large-scale soybean farms. In the early 1990s, the State Agency for Environmental Protection used moneys from a WB-funded development project (*Projeto Nordeste*) to train a group of local farmers as park wardens and agricultural extension work-

ers. Thus, a positive relationship developed between the environmental "police" and the local "poachers" whose livelihood systems caused minimal impact on the ecosystem. The latter provided intelligence to the State Environmental Protection Agency about occasional transgressions by hunters and surveying parties working on behalf of soybean farmers, and called in the State authorities to adjudicate in matters of conflict with the cattle producers. When *Projeto Nordeste* ended in 1996, this mutually dependent relationship between the Local Environmental Agency, local farmers and cattle producers survived in part, even though the State Government refused to pay the Park wardens' salaries. In 2002, agreements were established between the Local Environmental Agency and the Water Distribution and Treatment Company, as well as with a private sugar cane producer whose lands border the Park in the east (Pereira 2003, pers. comm.) to fund both the Park wardens' salaries and the maintenance of essential Park infrastructure. Thus, while the Local Environmental Agency has been unable to directly manage the Mirador Nature Reserve, its recent alliance with local communities and the private sector has enabled it to find adequate human and financial resources to protect the area.

### 5.4. Which Button to Press?

The section on "where are we?" described the present tropical forestry system as a disjointed set of subsystems, frequently at odds with one another, and operating at local, national and international scales. In the next section, we described the desired state, which can be represented as a joined-up version of this modular forest model. To get there, we contended, requires empowering local communities to invest in the long-term maintenance of their resource base. Achieving this state requires all stakeholders to sit at the negotiating table, which defines a new role for the state as *facilitator* rather than *manager*.

The fact that what happens at the level of the forest management unit depends on what happens in its direct neighbourhood, which itself depends on policies and institutions, as influenced by the international dynamics, points to the "policies and institutions" box as a potential "acupuncture" point to help the forestry system towards recovery.

Land tenure and access rights are powerful examples of how policies and institutions might affect local behaviour, and this is illustrated nicely in the case of the multi-layer conflicts in Sikka. Getting tenure and access rights to properly motivate local communities to take adequate care of their environment is also illustrated in the hills of Kulon Progo Regency

in Yogyakarta Special Region, Java, Indonesia. In this region, farmers voluntarily plant multi-layer tree systems on sloping agricultural land held under private ownership, and have planted annual crops on the denuded slopes of the National Forest Estate which they invaded with local government collusion after the collapse of State control following the political crisis in 1997/98. When asked why they did not consider planting tree crops on the denuded forest land, such as on their own agricultural land, farmers stated that investing in tree crops would be risky because they did not know whether they would eventually be allowed to reap the benefit from this investment in the future. When given access and usufruct rights over this land earlier this year in a national government-sponsored "forest for the people" scheme, farmers have started organizing themselves to establish financially rewarding and ecologically sound agro-forestry systems (Chris Bennett, pers. comm., 2003). Getting access rights "right", however, is a hotly contested area for policy debate, with some arguing against full-scale private ownership as this would enable the owners of small land holdings to sell their assets to the better-off, with consequent loss of an important component of the food safety net of the rural poor (Wahjudi Wardojo, March 2003 : opening address at the partners' meeting of the Indonesian Multistakeholder Forestry Programme).

Getting the policies and the institutions right means getting the conditions right for policy processes. An analysis of the problems facing policy processes in Indonesia prior to the 1997/98 crisis points the way towards possible interventions (fig. 5).

Nowhere is the need to get the enabling conditions for an effective *policy process* right more obvious than in the case of illegal logging, where years of attempted law enforcement through command and control across the tropics have failed to make a change. Michael Pendleton, a law enforcement specialist for the management of natural environments in the US, made this point very clear in a recent Workshop on Law Enforcement and Poverty in Bogor when noting that law enforcement in such systems could never achieve results "in the absence of voluntary enforcement by local communities" because of the impossibility of command and control operations to effectively cover, or even scare off, illegal operations in such vast territories. Law enforcement only works when laws are constructed through a process which is accepted/owned by those whose livelihoods are affected by these laws. This requires a working social contract between the local community and the State, a condition which is not met in many tropical forests.

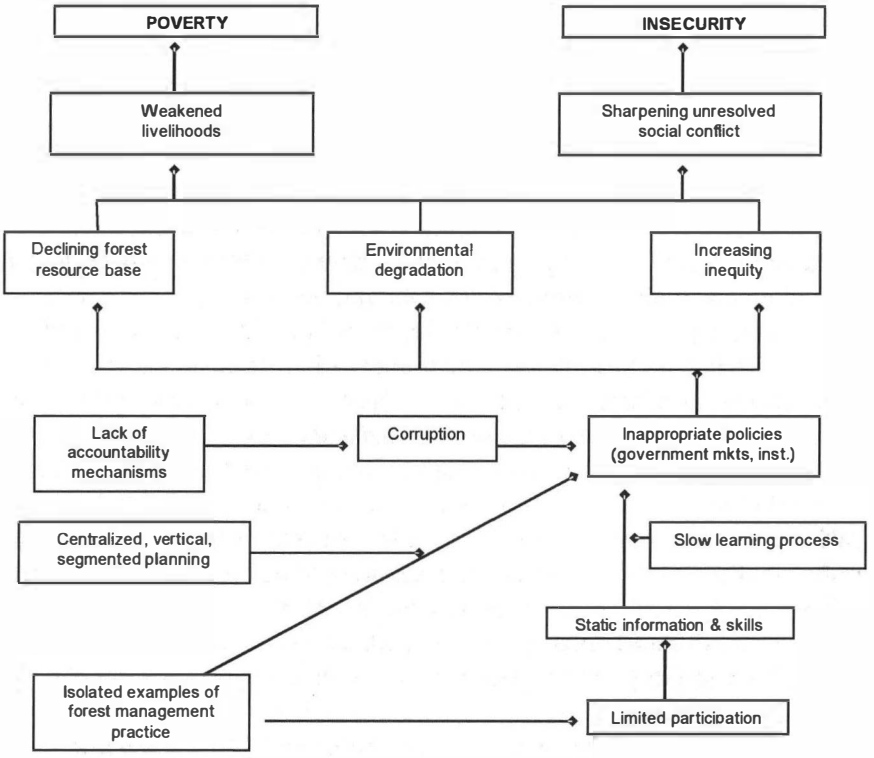


Fig. 5. — Multistakeholder Forestry Programme. Problem Tree.

## 5.5. A Forest Policy Toolkit

Managing people rather than trees requires a new toolkit. In this section, we offer some ideas based on what is currently advocated by natural resource management specialists. We organize our toolkit according to the layers in the forest model presented in figure 3.

### *5.5.1. Managing the Forest*

— *RIL* represents the first tool in our forest management toolkit : it is a tool for the large-scale timber harvester, and consists of a set of logging techniques that are recommended to reduce the environmental impact of selective logging from natural regeneration forests. It is widely advocated to forest concessionaires all over the world.

— *Community logging* such as introduced in numerous countries is an approach that combines timber production with the promotion of local development. While an obvious solution to regions where local communities dominate the landscape, they are, however, not easy to establish as they involve levels of organization that go outside the traditional organizational needs of the local community, and involve amounts of cash that communities have seldom had experience of dealing with. They frequently attract interests from the outside which end up corrupting fragile local social and business arrangements.
— *Multiple use forests :* natural forests do not only produce timber. They also produce non-timber forest products (NTFPs) such as Brazil Nuts in Brazil, and Rattan in Indonesia. Harvesting such products usually does not cause major ecological damage, and represents valuable additional income for local communities as well as for the national economy.
— *Agroforestry :* the emphasis on natural forests distracts the attention from the fact that they are not the only type of forest capable of providing useful environmental services. Many farmers in the tropics "construct" multi-species and multi-layer tree systems that combine intensive production of valuable commodities with the safeguarding of environmental services such as watershed protection. Expelling such farmers from sloping land and replacing their tree systems with planted stands of fast-growing exotics is as dubious an intervention to safeguard the environment against erosion as is removing traditional herder from semi-arid rangeland in favour of large-scale ranching in places such as Botswana (Biot 1993, Abel 1993).
— *Participative management of nature reserves :* point 5.3.1. illustrated the case of local people being involved in managing the Mirador Nature Reserve in Brazil. Numerous examples exist where such approach has been attempted, and various types of alliances between local communities, international conservation NGOs, the private sector and national governments are currently being explored world-wide.
— *Law enforcement by local communities :* point 5.2.1. illustrated an example of law enforcement by the local community which is proposed as an additional tool in the new forester's toolkit. The *Perekat Ombara* system in North Lombok, as well as the joint state/community run law enforcement system in Mamiraua Nature Reserve in Amazonas, Brazil, are other examples of this approach.

*5.5.2. Managing the Landscape*

— *Participative land-use planning*, often based on *community resource mapping,* holds the key to successful co-management of complex landscapes at the level of the village community, the watershed, the district/municipality, the nature reserve. Community mapping in Indonesia is a powerful tool to ascertain community claim on the land, even though such maps frequently do not have "legal" value. The process of mapping itself fosters reflection and dialogue within the community on how the land is managed, and how this may be improved.

— *Multistakeholder dialogues* often accompany participative land-use mapping initiatives, and aim at an agreed strategic plan for forest utilization in the village, district or municipality, the State or Province, the Nation. The latter are usually expressed in the form of a *National Forest Programme.* The processes leading up to such strategic plans are similar to those considered under local and / or national Agenda 21. Where conflicts are rife, such dialogues need respect basic principles of conflict management. In Indonesia, the experience of the Multi-stakeholder Forestry Programme has shown that, while difficult to manage at times, such dialogues hold huge potential to rebuild fragile social contracts between stakeholders. Key to their success is the inclusion of all parties, especially also the one(s) responsible for key legislation, such as local and national government. The failure to adequately include the concerns of the latter has been identified as the main reason for limited success in some such dialogues in Indonesia (FAHMI *et al.* 2003).

— *Co-management agreements,* also referred to as *joint management agreements,* are a potent tool to ally the comparative advantages of several stakeholders. Joint Forest Management (JFM) has set the tone in India where such agreements are made between local communities and the State forests services. In Indonesia, several such agreements have emerged between local communities and concessionaires, including Perum Perhutani, the State-Owned Company responsible for forest management in Java. In one case in South Kalimantan, a concessionaire negotiated such agreements which involved benefit sharing and the promise of minimum labour adsorption to deal with rampant timber theft by the adjacent local communities (Philippe Lyssens, pers. comm., 2003). Other such agreements are attempted between local communities and the management of nature reserves such as in Papua, with facilitation from WWF.

— *Decentralization :* managing landscapes with multiple land claims requires a local brokering and facilitation capability that only local government can provide. This requires proper empowerment of local government within clear limits set from above. The balance between local empowerment and flexibility on the one hand, and norms to define the zone within which it is permissible to negotiate on the other, is notoriously difficult to define, and represents one of the main challenges facing forest management in Indonesia.

*5.5.3. Policies and Institutions*

— *National Forest Programmes (NFP)*, briefly mentioned above, are a powerful tool to construct a national consensus on the desired state of the forest, and form a useful basis for strategic planning and the derivation of basic norms and regulations. When the temptation to call in "specialists" to write such programmes is resisted, and the process involves truly *public* consultations, NFPs go a long way towards constructing socially agreed norms, and rebuilding social contracts between the community and the State.
— Adopting basic principles of *Good Governance,* including *transparency* (such as in the issuing of concession rights), *participation and accountability* will go a long way towards effective policy implementation and law enforcement, and the rebuilding of trust in the State. *Independently verified log tracking* chains are an essential tool to promote good forest governance in the timber industry.
— Reaching a *balanced and mutually agreed distribution of roles and responsibilities amongst the different sectors of society,* including government agencies, civil society in general and local communities, non-governmental organizations and the private sector specifically will also contribute to improved social contracts.
— *Non-governmental organizations (NGOs)* play a crucial role in bringing forward the case of proper forest management, in a variety of guises. These include : advocacy, on behalf of conservation and indigenous people and basic civil rights issues, such as the *Sociedade Maranhense de Direitos Humanos*, an NGO specialized in the rights of Brazil's *Quilombos*, descendants from freed African slaves ; independent watchdogs, such as the Environmental Investigation Agency, an international NGO partnered to TELAPAK, an Indonesian NGO, both active in gathering and divulging intelligence on illegal logging ; and service provision, such as ASSEMA, an organization providing

extension services to local farmers in the State of Maranhão, Brazil, or SHK-Kaltim, a similar organization providing extension services to rattan producers and community loggers in East Kalimantan, Indonesia.

— Reviewing the *role and curriculum of forest professionals* might also be considered to help prepare the profession better for its new role in social and political issues related to forest management.

*5.5.4. International Influence*

— *Regulating the international trade* in forest products could contribute significantly to a reduction in trade of illegally harvested products if consumer countries were able to agree with producer countries on what constitutes "legal" and "illegal" harvesting, and if such agreements could be translated into instruments that can be used by Customs and Excise authorities in both producer and consumer countries. To date, only species listed under *CITES*, such as "Mahogany" for Brazil, and *Ramin* for Indonesia carry internationally valid trade restrictions. Other species of timber harvested illegally in, say, Indonesia, cannot be barred from entry in a country such as the UK, until a valid agreement governing such species exists between both countries. FLEG, the Forests Law Enforcement and Governance initiative, started in Bali in September 2001, and now subscribed to by a growing list of consumer and producer countries, has been translated into a number of bilateral Memorandums of Understanding such as the MoU between the UK and Indonesia that attempt to establish such trade instruments.

— *BIOTRADE* promotes the trade in forest products that have been produced, processed and marketed in ecologically and socially sound ways. Examples of such initiatives are the *Bolsa Amazónica*, initiated by POEMA, an NGO associated with the Federal University of Pará in Belém. A similar initiative was recently launched in South Africa, and efforts are currently underway to promote such mechanism in Indonesia.

— *Certification* of forest products as having been produced, processed and traded in ways which conform with internationally agreed principles of sustainable forest management is an international market mechanism which can be considered as counterpart to the efforts by consumer and producer countries to regulate the trade in *legal* forest products. Certification is currently a very costly exercise, and ill-adapted to the needs of the small-scale producers.

— *Regulating international finance* has been proposed by Chris BARR (2001) from the Centre for International Forest Research to try and diminish the probability of international finance subsidizing ecologically and socially inappropriate investments, such as Pulp and Paper plants with inadequate areas of planted forest which frequently operate in regions with contested land claims. Regulations considered under this item include such rules as govern stock exchanges, similar to the set of due diligence rules that govern international investments in the mining industry and money laundering legislation, such as in the case of Indonesia which now incorporates forest crime as a possible reason for prosecution. While awaiting the emergence of agreed regulated due diligence procedures, the research and advocacy efforts of this work so far has been sufficient to prompt the industry itself to seek agreement on norms and procedures with national and international non-governmental organizations, such as in the case of the US$ 13.5 billion indebted Asia Pulp and Paper company in Indonesia.

## 6. Concluding Remarks

This paper started with the claim that timber extraction from natural forests in a way that does not threaten this ecosystem's survival is technically feasible. We then moved on to show that this technical "solution" is not applied in reality, and that tropical forests are disappearing fast. We pointed the finger at the loggers themselves, who are seemingly unable to implement the technical solutions promoted by forest scientists, but also at competing stakeholders who have alternative and competing uses for the land which is currently used for timber production. We thus moved from "forest" to "forest land" management, as proposed by NUGROHO (2003). We briefly looked into the past, and showed how important decisions by the State in the 1960s-70s have had a profound impact on forest land governance. These decisions have eventually led to the present situation which can be described in terms of a "tragedy of an unmanaged commons". Solving the problems facing "forest lands" needs rely on the acknowledgement of this "tragedy of the unmanaged commons", and a number of possible interventions were proposed that hold promise for the future.

Given the forces that are at play in the tropical forests, it is easy to doubt that they are likely to survive the present onslaught of human

greed. The underlying problems of weak social contracts between society itself and the official State mean that lasting changes need rely on an improved governance environment, which goes well beyond the professional scope of the traditional forest engineer, and takes time. In the meantime, forests disappear, and it is easy to be tempted to look for easy shortcuts that often repeat former governance trends and are likely to worsen rather than improve the relationship between State and society.

In the face of almost impossible policing challenges, the only way forward is to enable the forest-human system to autoregulate itself. This requires empowering local communities, local government and the private sector, both locally and internationally, and looking for compromises between all land users, or stakeholders, such as was illustrated for the case of the Mirador Nature Reserve. The existence of numerous local examples of successful multi-stakeholder forest management in both Brazil and Indonesia, and the present trends in the international market of tropical timber give us confidence that this is the right way to go.

Does this mean that the natural tropical forest landscape as we know it today will remain unchanged — I do not believe so. Present trends and the need to intervene at the very root of society's relation with the State before lasting management systems will emerge mean that much natural forest will be converted in other vegetation systems. The future tropical landscape will likely consist of a mosaic of land-use systems, including large areas of more or less managed natural forests, some patches of natural forest managed for timber production, large areas of tree plantation and pastures and medium-scale agroforestry systems. In choosing the way to influence the future, we may need to shift our emphasis from trying to protect what cannot be protected, to *(i)* prioritizing protection where it can be achieved, and *(ii)* guiding the evolution of the future tropical landscape mosaic in a way which optimizes benefits to all genuine stakeholders, including local communities.

## DISCLAIMER

The views expressed in this paper are those of the author. While largely consistent with practice in numerous DFID-funded initiatives across the world, they are not an official expression of UK Government policy on tropical forests. Details regarding the latter can be obtained from the Department's website at : www.dfid.gov.uk.

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# Sustainable Timber Production in the Democratic Republic of Congo — Lessons from a Successful Experience in the 1980s

by

Honoré PAELINCK *

## 1. Introduction

Yuki, a village on the right bank of the Kasai river, 110 km downriver from Ilebo (former Port-Francqui), was a leftover from the period when river barges were towed by tugs driven by wood-fired steam engines that took on a fresh load of cut wood as fuel. When steam power was replaced by diesel engines, the site was converted into a sawmill. The sawmill installations, workshops and housing had been built in the 1950s in brick made from a clay quarry in the Kasai river. The total concession of ONATRA [1]** was 28,000 hectares.

In 1979 the small village was found left to its own. Daily trade convoys would pass by on their way to Ilebo to pick up a full load of copper, but it took a solid five days by boat from Kinshasa and there was scarcely any one to stop at that place.

## 2. What was left in 1979

Yuki had been a village existing for ONATRA only. Since 1979, the 89 staff members and their families, consisting of 206 women and 321 children, tried to survive on agriculture — the women to grow

* Member of the Academy; former Chairman Managing Director ONATRA (1977-1985).

** The numbers in brackets [ ] refer to the notes and references, p. 118.

cassava and groundnuts and some excellent hunting for the men. The nearby forest assured an ample supply of dry wood for cooking.

Reaching Yuki needed a boat trip with one of the regular convoys to Ilebo that passed there three times a week in each direction, bringing supplies to Shaba (former Katanga) and taking copper back downriver. Timber was no high priority and as a result there was scarcely a boat to stop there. Maintenance of all equipment finally stopped after all spare parts had run out and the only occupation left was receiving salaries from the only monthly convoy that made a short stop for that purpose. Any evaluation to restart productivity was considered a serious problem, as a one-day visit required a total safari of ten days, with five days' upstream and four downstream for only one day at the site itself.

## 3. A New Start

With no more supplies from its own mill, ONATRA's timber needs were covered by the purchase of different sizes and brands on the local market in Kinshasa at exorbitant prices. While the possibilities for own timber production were obvious, accessibility was the main problem.

During a short inspection visit in the Yuki area, a plan was developed to create a small airport in the immediate vicinity of the village. Close by, the forest had already been cleared around the village by the local people who generally do not support the proximity of a closed canopy. The railroad department supplied a pay-loader, a leveller and a compacter and with the help of the local staff a grass-covered airfield of 800 by 50 m was constructed. After three months, the grass had grown sufficiently so that an inspection team of the domestic air administration could verify and certify the airfield. Their request to add a pole with an airbag to indicate wind direction was immediately complied with. Total cost price for the new airport was 460,000 zaires, transport of equipment, fuel and salaries for personnel included.

Technicians, who now could be brought on the spot in ninety minutes' time, identified the required spares to restart operations of cutting logs, transport to the mill and making the sawmill machinery work again. Fuel was required for the tractors, trucks and buzz saws. Power for the sawmill required an old steam generator (Karels and Van de Kerckhoven – Gent 1911), with a huge flywheel, still in perfect working condition and strongly positioned alongside the mill. The steam boiler had disappeared though, and the electric power unit had to be rewound after being at a

standstill for nearly half a century. In Kinshasa, a large number of old wrecks of steam tugs were still moored on the river in front of the shipyard, while a steam boiler was lifted out from the abandoned "Prince Albert" boat, together with a large number of brand-new flame pipes, and the whole installed in Yuki. Steam could now be made with the leftovers of the sawmill (it is rarely known that the sawing of logs leaves a residue of about 50 % of the total mass), and an average production capacity of 300 KVA was reached. This was more than enough to provide electricity for three belt saws, smaller electric handsaws and leaving a comfortable reserve. Total cost price of diesel fuel brought in, spare parts and technicians' salaries amounted to 240,000 zaires.

Total restart cost amounted to 700,000 zaires.

## 4. Timber required by ONATRA

Under the auspices of the Ministry of Environment, Nature Conservation and Tourism a special team of Canadian experts had made a forest inventory of the so-called "Cuvette centrale" (Equator region) in 1977. On the basis of this study, ONATRA was able to identify the types of trees in its concession and to prepare a plan for gradual road development, designed for specific access to the required wood species in a recurrence cycle of some fifty years.

The wood species used were : wenge, limba, kambala, iroko, tola (for housing [2], furniture, pallets), sapelli, sipo, lifaki, afromosia, mukulungu (for railroad sleepers for points, crossings and switches).

At the restart, a volume of about 50 $m^3$ of timber of different size was carried out each week. But within three months, the total production volume went up to an average 500 $m^3$ per month exceeding the estimates by 100 %. The price of the lumber produced monthly was now more than 1.5 million zaires, thus restricting the payback period for the airport and all extras to about fifteen days.

## 5. Interesting Spin-off Effects

The rather inventive mode of restarting the enterprise not only delivered a range of by-products, but was also at the root of new and quite remarkable side effects within the local human environment.

### 5.1. Power

Electricity from the steam-driven power plant, fed by the leftovers of the sawmill, required 24-hour continuous working in order to keep up sufficient steam pressure for working the mill during daylight hours. It would have been a pity to let the generated electricity go to waste. Hence, power was installed in the house of all personnel. Immediately, suggestions were made to create a club. During their time off, the staff started to build a neat cottage with veranda and wooden seats and tables and a bar with proper tools. What became a necessity was a refrigerator for cold beer, and television. But, situated too far away from any emitting station to capture anything, the only solution was a VCR tape recorder. All embassies in Kinshasa received a polite letter asking for educational tape programmes on loan (to be returned after projection). A weekly air connection with Yuki shuttled the tapes.

### 5.2. Health

The weekly shuttle brought medical services to the site, including doctors with varied specializations visiting regularly, and another dispensary was established. Before that, the nearest hospital was in Ilebo (110 km away). The staff number was evidently excessive for the sawmill itself so that other employment was looked for.

### 5.3. Charcoal Production

Cooking in the cities is usually done on charcoal, when available, and shortages were regularly creating a large demand ratio. The huge trees felled in the forest, cut into logs and trucked to the mill, also left an enormous quantity of branches to rot. These branches had a diametre of 20 to 50 cm and could therefore ideally be used for the production of charcoal. The project was studied in detail and provided an extremely comfortable IRR (Internal Rate of Return) of over 100 %. In reality, it became 190 %. The Canadian embassy generously provided, free of charge, plans and a technician for the construction of the charcoal ovens. But bricks were required. The first oven was built with bricks bought in Kinshasa. During the period of preparation and transport of the Kinshasa bricks, a clay quarry was established in Yuki itself and bricks were moulded locally, dried and hardened and served for the construction of

the next nine ovens. In total, ten ovens were constructed : one by the Canadian expert himself, three more under his direct supervision, and the rest by the now experienced local personnel.

Monthly production amounted to an average 100 tons of charcoal, which was transported in jute bags to Kinshasa for consumption by ONATRA's personnel, and the rest to hotels for their weekly BBQs.

There was still personnel left.

### 5.4. Plantations

In the immediate vicinity of the village, the forest had already largely disappeared. Open space was thus not only available for the airport, but also for agricultural purposes. One of the major shortages in developing countries, is the availability of foreign currency. This can be obtained by the sale of produce required on the international market. A coffee plantation was planned. A specialized agricultural engineer was engaged, and with selective seed coffee of the robusta variety, the slow and tedious process of a coffee plantation started. (It takes more than three years for a coffee tree — rather a bush — to produce beans. The trees are planted with a space in between of about six metres to allow the branches to spread equally. The original plants are small and the open area should not be allowed to overgrow with the local grass type — *Paspalum* — that uses a lot of nitrogen, an important nutrient needed for the growth of the coffee plant.)

In the absence of fertilizers, due to insufficient cash, the alternative was to put food crops between the coffee plants : corn (maize), groundnuts and mountain rice. During the first years, three harvests per year of corn (white, yellow and red) and groundnuts and two of rice could be obtained. As the plantation was regularly expanding, every year, the farmers continued to harvest the intermediate products on a regular basis.

### 5.5. A New Port

The steadily increasing output of all these products called for expansion of the port facilities. Wooden sheet pilings (in *mukulungu*) with tensioners were used for a new berth, where two barges could be anchored. Yuki thus became now a regular stopping place of passing convoys leading to advantageous commercial dealings with the local inhabitants.

### 5.6. Social Evolution

During the lag period, the mentality of the entire population of Yuki was rather defeatist and people believed in survival economy only. The subsequent rapid economic development changed the local mentality in a most positive sense.

Once again with leftovers of the sawmill, classrooms were built for children of different ages and the manager of the mill went over to the local provincial governor to ask for teachers. Yuki did receive them and the teachers were extremely happy to work there since they received housing and were regularly paid by ONATRA.

After an operational period of three years, another remarkable spin-off effect was reported by the director of the medical department : the birth rate at Yuki had dropped dramatically! The explanation given was : electricity and television.

## 6. Conclusion

Development can be stimulated by a pragmatic, practical approach and with relatively simple means. In a period of three years, and as a result of the new developments at Yuki, the attitude of the population dramatically changed and resulted at the same time in a remarkable respect towards the forest, as a guarantor for their long-term livelihood. It was the best reward for all the efforts spent.

### NOTES AND REFERENCES

[1] ONATRA (Office National des Transports — The National Transport Organization) was owner of a 28,000 ha forest area along the Kasai river in Congo (former Zaire). The organization also ran the seaports of Matadi, Boma and Banana, the railroad Matadi-Kinshasa, the river transport system of 11,000 km long with river ports, three shipyards, seven hospitals, four maternities, fifty-six dispensaries, nineteen schools, four plantations and 27,000 staff.

[2] Most of ONATRA's personnel was housed and a total of more than 22,000 houses had to be maintained in camps for workers, flats and villas for staff.

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# Do Biodiversity Issues and Rural Development Objectives Fit in Forestry Management Plans ? A Presentation of WWF Experience in Central Africa

by

Emmanuel HEUSE *

## Global Background

In order to allow for a sustainable exploitation of their 200 million hectares of natural forests, the *four major* forest countries of Central Africa have engaged into the development and tentative implementation of a comprehensive and demanding forest legislation over the last decade. These efforts have been spurred, and sometimes urged, by constant international involvement and pressure.

The new forest laws of Cameroon (1994), Congo-Brazzaville (2000), Gabon (2001) and DRC (2002) now specify stringent compulsory management conditions in order to insure that logging operations in awarded concessions are sustainable. The development of a forest management plan is a prerequisite to any long-term attribution. This in turn requires that management inventories are conducted, that local populations are consulted to define the area relevant to their activities, that biologically sensitive areas are identified, and the logging zones defined accordingly.

Nevertheless, most concession holders still consider the obligation to develop a management plan as an extra type of taxation, rather than as the expression of the normal way of running a forestry business. In line with that attitude, the concession holders either try to do nothing at all or just

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let the management plan be written by the cheapest bureau available, not worrying about the quality of the work provided as the intention to actually use it is completely absent.

Against this unfavourable global background, the rare logging companies committed to change their working habits and to comply with the law are faced with competition distortions and threaten to review their initial commitment if illegal logging continues to spread unabated.

But how committed are they, and what can they reasonably be expected to achieve? WWF strongly believes that the self-proclaimed willingness of these companies to invest in the long term and to implement sustainable forest management and possibly independent certification can be tested — and simultaneously sustained — through controlled support in the framework of partnership agreements. These partnership agreements should at the same time help partner logging companies to adapt their operations to long-term objectives and be conducive to effective progress of sustainability on the ground, within their logging permits.

As far as tropical forestry is concerned, promoting sustainability of logging amounts to integrate non-profit-oriented activities such as biodiversity conservation and social development into management objectives. It is a complex problem as such in tropical forestry, probably even more acute in Africa than in other tropical forest areas of the world. To achieve sustainability, logging operators, which are profit-oriented actors, are requested to invest into numerous non-profit activities, many of which should normally be covered by public expenses.

Some costs related to biodiversity conservation and social development, however, are directly linked to exploitation as such and should therefore be borne by logging operators. These are linked to the following activities:

— Conduct management inventories of timber resources to establish key management parameters such as cutting cycle and minimum cutting diameters;
— Establish detailed maps of concession areas;
— Elaborate and implement a forest management plan according to legal requirements;
— Conduct exploitation inventories and post-harvest inventories (follow-up and monitoring);
— Implement Reduced Impact Logging techniques (felling, skidding, and roads network) and insure safe working conditions;

— Insure proper living conditions for workers and their relatives on logging sites.

But other costs related to biodiversity conservation and social development fall arguably beyond the responsibility of logging operators, and should therefore benefit from some sort of public support (which often amounts to international aid in the case of African forests). These are linked to the following activities:

— Conduct management inventories of all major forest resources, including biodiversity and Non-Timber Forest Products (*NTFP*).
— Improve scientific knowledge of logged species and forest stands dynamics, in order to fine-tune management parameters. Develop opportunities for natural regeneration of logged species.
— Identify and set aside forest areas of high conservation value.
— Conduct sociological surveys to assess the level and nature of interactions between local populations and forest areas within/around logging concessions.
— Support local development initiatives in favour of workers and their families on logging sites.
— Control hunting and the bushmeat trade. Develop sustainable alternatives to bushmeat consumption within/around forest concessions.

The integration of these non-profit-oriented activities in logging management is a huge challenge for the conservation of the 200 million hectares Central African natural forests. The structural weaknesses and lack of means of local official bodies and forestry administrations, aggravated by the counter-productive influence of widespread corruption, makes the development of full-fledged management plans extremely difficult even for committed logging companies. These companies face competitors that do not bother about law-compliance, but are nevertheless tolerated by the authorities (as they often work hand-in-hand with top officials) and are therefore allowed to completely disrupt the national and international timber markets (tab. 1).

**Table 1**

The costs of sustainable forest management in Central Africa

| | | |
|---|---|---|
| Elaboration of management plan | 3 to 5 euro/ha | (*Source* : FRM 2002) |
| Elaboration of management plan | 3 to 3.5 euro/ha | (*Source* : ATO 2002) |
| Elaboration of comprehensive management plan (incl. biodiversity and development) | 5 to 7.5 euro/ha | (*Source* : WWF 2000) |
| Elaboration of comprehensive management plan (incl. biodiversity and development) | 3.5 to 5 euro/ha | (*Source* : Sylvafrica 2001) |
| Implementing a comprehensive management plan (incl. biodiversity and development) | 5 to 15 euro/ha | (*Source* : WWF 2000) |

Against this background, the development of law-abiding and comprehensive management plans in Central Africa, hence the possibility to supply European markets with sustainable tropical timber from the sub-region, are very unlikely if "committed" companies do not benefit from some sort of external support.

## WWF Actions

As far as logging in the Congo Basin is concerned, the global strategic vision of WWF is that timber exports towards international markets can hardly be considered as legitimate if significant progress is not simultaneously promoted and achieved in the sustainability of logging operations. In that regard, WWF does not wish to promote one-shot projects with a limited number of leading companies, but to provide a global framework — including the promotion of independent certification — in order to achieve a significant improvement of sustainability throughout the vast majority of the logging sector still linked to European financial and trade interests [1] *.

It is WWF point of view that if the international community — and more specifically the EU countries — are to elaborate a conceivable solution for the sustainable management of logging concessions in the Congo

* The numbers in brackets [ ] refer to the notes and references, p. 125.

Basin in the foreseeable future, action must be taken rapidly in close relationship with the few committed logging companies supplying tropical timber to the European markets. Actions taken now may still have a positive influence and revert the current trend towards a generalization of illegal practices and uncontrolled logging in the Congo Basin. Further delay would probably make future solutions even more complicated.

Over the last seven years, WWF has played a substantive role in the promotion of certification as a tool to foster sustainable forest management in the Congo Basin. Thanks to financial support from the Tropical Forest Budget Line of the European Commission and the Environment and Development Department (DML) of the Dutch Ministry of Foreign Affairs, WWF initiated two projects specifically focusing on the promotion of SFM and certification in the timber-producing countries of West and Central Africa [2]. Main project achievements included the following :

— Establishment of National Working Groups on Certification in Cameroon and Gabon, dedicated to the development of national standards for certification in these countries.
— Organization of workshops and seminars to introduce certification issues to stakeholders in forestry issues in Central Africa (administrations, logging companies, students, NGOs).
— Capacity-building activities in order to develop local expertise in SFM and certification.
— Awareness-raising campaign and trade-related activities in importing countries of Southern Europe. Efforts concentrated on the establishment of Buyers Groups in importing countries, regrouping timber importers, industrialists and retailers willing to develop environment-friendly purchase policies through the promotion of certification.

At the policy level, participatory processes and local involvement in sustainable forest management have been significantly strengthened. Development of SFM standards in the framework of national working groups has been widely recognized as an original process involving relevant stakeholders in a flexible way of working. Capacity-building activities for the development of a local expertise in SFM and certification issues have also constituted an important output of WWF projects so far, although much remains to be done in this regard [3].

In 1998 and 2000, two partnership projects were also launched with logging companies operating in Gabon. These projects were developed thanks to funding agreements provided by the MFA of the Dutch

Government under the framework of PIN 1996-2000 [4]. They allowed for the development of practical field solutions to facilitate the integration of environmental and development objectives in the management plans of logging companies. These easy-to-implement instruments include the following :

— Identification of high-conservation (biodiversity rich) forest areas and delimitation of conservation series in management plans ;
— Wildlife management ;
— Forest stands dynamics and improvement of natural regeneration in logged areas ;
— Reduced Impact Logging techniques, including post-harvest inventories and monitoring ;
— Sociological surveys to assess the level and nature of interactions between local populations and forest areas within/around logging concessions ;
— Delimitation of farming series in management plans ;
— Identification and management of joint development initiatives such as development funds ;
— Improvement of living conditions on forest sites.

Among the few logging companies committed to SFM practices in Central Africa, pragmatic solutions to progress towards SFM are now considered as feasible options, and partnerships and external monitoring are increasingly seen as acceptable means to achieve significant results in this regard [5]. The link established within the framework of partnership projects between technical assistance (in biodiversity management and local development for instance) and progress towards certification are welcomed by an increasing number of hitherto reluctant logging companies.

Against this overall background, the EU has recently accepted to provide WWF with a new financial assistance for the development of a network of "committed" logging companies, engaged in a closely monitored step-by-step progress towards sustainable forest management and independent certification, and which could possibly provide "second-best" sustainable timber to European markets. Within the framework of this new project, several partner logging companies currently benefit from technical assistance and progress monitoring over the period 2003-2005. The partnerships serve as a means to provide technical assistance to law-abiding logging companies in order to facilitate the implementa-

tion of conservation and local development activities that fall beyond their direct responsibility (*i.e.*, the second group of activities described above).

Throughout the new EU project, and throughout possible complementary support by other donors, WWF is trying to gather a politically influential momentum by signing as many logging companies as possible in closely-monitored partnership activities aiming at sustainable forest management and certification. With major logging companies engaged in profitable partnerships and progressing towards SFM, efforts to crack down rampant illegal logging activities are expected to be facilitated throughout the region and the whole sector would benefit from a better overall context.

## NOTES AND REFERENCES

[1] The long-term trend for international trade of African timber will probably be Asia, where demand keeps building up, while supplies possibilities offered by Malaysia and Indonesia are bound to weaken in the coming years. It will be much more difficult for European actors to influence the local situation in the Congo Basin once the exports of African timber are primarily directed to Asia.

[2] Project B7-5051/95.8/VIII and project B7-6201/97.5/VIII/FOR (DGIS project reference WW113418).

[3] The whole legitimacy of the certification process will understandably be questioned over and over by local stakeholders if it keeps failing to include local capacities.

[4] A first project initiated with logging company SHM, 320,000 ha, in 1998 (DGIS activity WW113427) was followed by another project with CEB, 605,000 ha, in 2000 (DGIS activity WW113451).

[5] Needless to say, partnerships with logging companies rest upon a closely monitored respect of stringent conditions regarding law compliance and sustainability of operations. In this regard, the set of related minimum requirements developed in collaboration with representatives of the logging sector over the last two years is another major output of WWF projects.

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# Report

by

Walter Loy *

This workshop, the second of three, is held in the premises of the "Palais des Académies" in Brussels, under the title of "Sustainable Management of Tropical Forests".

The workshop is opened by Prof. Y. Verhasselt, Permanent Secretary of the Academy, and by Prof. M. De Dapper, Chair of the "Environment and Development" Commission.

An *introduction* is given by **J.-P. Malingreau**, Joint Research Centre of the European Commission and Chairman of the working group for tropical forests. The purpose of this workshop is to maintain wood diversity, to analyse the different interests with conflicting views and to formulate a legal framework as part of a sustainable management.

**Y. Biot**, Programme Coordinator, Member of the Academy. — *Sustainable Management of Tropical Forests. The Road Map for Effective Targeting.*

An annual productive capacity of sustainable-managed natural tropical forests amounts to about 0.75 to 1 m³/ha. This productive capacity has a negligible ecological impact, especially when it is complemented with "Reduced Impact Logging" (RIL) practices. It is feasible to realize a sustainable harvest. This means maintaining a constant productivity respecting the biodiversity and the hydrological cycle.

Despite this knowledge, forest destruction continues unabated. The symbiosis of the indigenous people with the forest is in contrast with the post-independence mining of forest resources for economic growth.

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The management decisions on the local political economy have to be adapted to the overall policy process (see the G7 pilot Programme for the Preservation of the Tropical Rainforests of Brazil and a test through reciprocal agreements between the UK, Japan, the EU and the Republic of Indonesia).

The international environmental movement has drawn the attention to the tropical forest as a crucial factor to maintain the global climate and a minimum level of biodiversity.

**H. Paelinck**, former Chairman Managing Director of ONATRA 1977-1985, Member of the Academy. — *Sustainable Timber Production in the Democratic Republic of Congo — Lessons from a Successful Experience in the 1980s.*

ONATRA (Office National des Transports) was owner of a 28,000 ha forest along the Kasai river near Yuki (110 km downstream from Ilebo, former Port-Francqui). When steam power (for the river barges) was replaced by diesel engines, the site was converted into a sawmill. Twenty years after independence, Yuki was left to its own development.

ONATRA started the timber exploitation by improving accessibility and production, while a number of spin-offs not only delivered different products but also electricity, charcoal, plantation, a school and medical control. The attitude of the population with respect to the forest, as a guarantee for their long-term livelihood, was the best reward for all efforts.

**E. Heuse**, Tropical Forest Unit, WWF Belgium. — *Do Biodiversity Issues and Rural Development Objectives fit in Forestry Management Plans ? A Presentation of WWF Experience in Central Africa.*

For the last couple of years, WWF Belgium has engaged in technical partnerships with several logging companies operating in Central Africa. These partnerships have focused on the integration of biodiversity and local development issues in the elaboration and implementation of forestry management plans. Progress has been recorded in several regards such as game management, regeneration studies or delimitation of "farming" and "conservation" series, but a complete integration of non-productive in global management remains troublesome. Striking a lasting balance between exploitation targets and sustainable development objectives remains an unlikely prospect in most cases.

## Discussion

The problem of producing *dioxine* by burning of wood. A suggestion is made to supply natural gas to Africa and to use other sources of energy in the Western World.

The growth of the population and the mining of forest resources are strongly competing with sustainable forest management.

There is still a great deal of uncertainty about the *forest certification*. Indeed, local people neither have any input on local policy nor any timber rights. International pressures could be more effective than legislation.

Workshop III (19 March, 2003)

# Tropical Forest and Industrial Society

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# Europe and the World's Forests

by

Bérénice MURAILLE *

*If we don't change direction soon,*
*we will end up where we are going.*
Irwin COREY

## Introduction

As opposed to the upbeat mood that followed the Rio Conference in 1992, there is a generalized feeling of despair among forest activists and foresters. The world's tropical forests continue to disappear with disheartening speed. Indeed, in spite of much talk and many international efforts, the pace of deforestation appears to have been almost as high in the 1990s as it was in the 1980s, when the world woke up to the issue. The United Nations' Food and Agriculture Organization (FAO) has just published a report on the state of the world's forests which estimates that, between 1990 and 2000, Africa's forest cover declined by 0.8 % a year and South America's declined by 0.4 %.

Causes that have led to forest destruction in recent years continue to operate with ever-increasing intensity. The World Bank [1]** recognizes that: "(it is) a largely false notion that the poor are the cause of deforestation in developing countries". The poor act as agents rather than causes of forest destruction. Major (underlying) causes of forest destruction and degradation have been identified: among them aid, trade liberalization, investments, consumption and production, land rights, land speculation, and land concentration, structural adjustment programmes.

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** The numbers in brackets [ ] refer to the notes and references, p. 139.

Through aid, trade, foreign investment and its consumers, Europe is a major force contributing to forest loss in the rest of the world, including in Eastern European countries and tropical forest countries.

## Aid

Taken together European Union's countries provide more than half of all development assistance to developing countries and countries with economies in transition. Aid to developing countries is causing forest loss both directly and indirectly, by failing to address underlying causes in recipient countries or even reinforcing them. While it is accepted that not all aid projects and programmes have damaging consequences, there is a clear evidence that aid directed at non-forest sectors, including sectoral and structural adjustment lending, often completely ignores the possible adverse impacts on forests. Structural adjustment lending which aims to promote exports and cut back national expenditures has often encouraged an intensification of forest exploitation without measures being simultaneously taken to strengthen governments' regulatory capacity.

In addition, aid funds have been provided directly to facilitate logging operations, to boost production from the whole forest sector, to facilitate clearance of forest lands for plantations or other agri-business, to build dams, to promote road building, to develop mines, etc.

A recent evaluation by the World Bank (2000) [2] of its forest project portfolio revealed that interventions in other sectors affected forests and trees to a greater degree than the World Bank's interventions in the forest sector itself. For example this and other studies show that:

— Structural adjustments to reduce salary expenditure may have been desirable from a fiscal point of view but resulted in a reduced capacity to carry out regulatory functions;
— New and improved roads to stimulate economic growth have attracted land poor migrants who then clear forest for agriculture;
— An increased demand for power has resulted to clear forest land to build more dams.

In spite of these, the revised Forest Strategy of the World Bank (2002) does not apply to its structural adjustment or programmatic lending nor to the Bank's private sector arms, the International Finance Corporation and the Multilateral Investment Guarantee Agency (MIGA). In addition,

the revised policy allows, among others, plantations to be established in forest, although it "prefers" these not to be areas specially cleared for the plantation. This is obviously a step backward from the previous Bank policy on forests (1993), which only permitted the Bank to fund plantations on non-forested areas or heavily degraded lands.

Trade and the provision of improved access to markets, both national and international, is a stated goal of the European Community development policy. A recent research of EC aid programming documents in highly forested African countries [3] highlights that almost 50 % of the aid provided by the European Commission in these countries for the period 2002 to 2007 will be allocated to large roads' building [4]. In Africa, roads are often in a bad state and many people want more and better roads. In addition, physical access to markets is important and road construction will contribute to solving this problem. However, in the absence of improved governance and forest law enforcement, road building programmes in highly forested countries could facilitate increased traffic in illegally and unsustainably sourced timber originating from within or outside any of these countries. In addition, in the programming documents, no clear case is made on how these roads will make a better contribution to poverty reduction aside from the hope for trickle-down effect nor is mention made of consistent standards for environmental impact assessment and sustainable environmental assessment. The potential impact of the EC aid programme on African forests is a cause of extreme concern.

## Trade

The economic policies currently in vogue encourage deregulation and private sector investment in export-oriented production. International legal regimes developed under the WTO actually penalize countries from restricting trade on environmental grounds as they are considered "non-tariff barriers" to free trade. This has made regulation of trade to prevent forest destruction difficult. As the regulatory capacity of the governments has been weakened while private sector penetration has increased, there have been growing opportunities for malpractice, such as political manipulation, bribery, and transfer pricing.

Worldwide, the quantity of forest products exported has doubled since 1970 and the value of forest products' exports has tripled between 1970 and 1995 to reach $ 152 billion a year. International trade now accounts

for 25 % of global production of wood-based panels and papers, 20 % of sawn wood and wood pulp, and 6 % of industrial round wood. Even though the international trade in timber and other wood products constitutes only a small percentage of all wood extracted from forests, **the global trade in quality timbers, and increasingly, in paper-pulp are major forces opening up forests to other interests**. Despite the small volume of timber entering international trade, this has a disproportionate large impact on those forests that are the richest in biodiversity.

Tariffs in the forest products' sector have for a long time been the lowest of all major industrial product groups, at 45 % below the average of all products. The Uruguay round brought the average tariff on forest products further down from 3.5 % to 1.1 %. Most studies have concluded that further tariff reductions in the forest products' sector will not have a major impact. However, low tariffs also encourage low timber and forest products' prices, encouraging growing consumption of quality timber all over the world.

Many other commodities traded in the world market are also implicated in forest loss. Mineral, petrol, gas, shrimps, cocoa, and palm oil are examples of commodities that are often extracted and grown in areas cleared of forests. International markets for many other cash crops (*e.g.* soja) cultivated outside forests also lead to forest loss by displacing peasant farmers from the best agricultural land and forcing them into the forests in search of a livelihood.

## Investment : the Case of ECAs

Private investment in tropical forest countries has had a growing impact on forests in these countries. In the last decade trade liberalization has pushed private infrastructure development and services around the world to replace public planning and financing.

Export credit agencies, commonly known as ECAs, have been set up in most OECD countries to promote national exports and help national industries abroad. Specifically they are public or parastatal agencies that provide companies with government-backed loans, guarantees and insurances against the commercial risks of doing business abroad. Indeed, few of these projects would go forward without the ECA services as private sector banks would not secure the high financial risks involved.

Today, ECAs provide the **largest source of government support** to large infrastructure projects in the South and in the East, underwriting

projects several times greater in value than the combined annual funding of all multilateral development banks. However, unlike these banks, the EU ECAs [5] are not subject to any binding environmental, human rights or development guidelines. In spite of being backed by public money, ECAs operate in almost total secrecy, are not accountable even to national parliaments, and are heavily influenced by industry lobbies. Not surprisingly perhaps, ECAs are involved in forest destruction and degradation in tropical countries undermining EU and host governments' international commitments to sustainable development.

The **Camisea Gas project** [6] in Peru involves the construction of wells, a processing plant and two pipelines to the Peruvian coast. The project, the first major gas project development in Peru, is located in one of the most ecologically-prized rainforest of the Amazon Basin and on territories claimed by indigenous peoples. According to the biological inventory of the Smithsonian Institute, the biodiversity of the Camisea region is unsurpassed in the world. The Netherlands Committee of IUCN stated that the Camisea region should be one of the last places on earth from which to extract fossil fuels. The $ 2.6 billion project is being supported by the Belgian ECA (*Office National du Ducroire*) and is being considered by an Italian ECA and a US ECA. Primary forest is being destroyed as the gas exploitation and processing part of the project are situated in primary forest — mostly tropical moist forest. The migration of people to the area will in all likelihood lead to conversion of the forest over the long term. Moreover, the gas development area covers legally titled territory of several isolated and uncontacted indigenous groups. For these groups, when the outside world begins to intrude aggressively on their territories and reduce their natural resource base, the pace of socio-economic and cultural change spins out of control, leaving isolated peoples to suffer from the effects of cultural dislocation and to grapple with social and health problems.

In **Indonesia**, European ECAs have also massively backed the pulp giant Asia Pulp and Paper (APP) [7]. Much of the rapid growth of APP in the nineties came from felling large areas of rainforest. As they cleared forests, APP moved on to new forest land rather than replant denuded areas. As a result, in 1999, only 13.4 % of its fiber was coming from second-growth plantations while the rest was coming from continually clearing out pristine rainforest.

## Markets and Consumption

Global consumption and the trade that services it has become the main motor of the global economy. Global per capita consumption has climbed steadily by 3 % per year for the last three decades, a trend that is projected to continue. Encouraging consumption is a fundamental objective of our economies, and industry, commerce and the media work together to promote it.

Markets have very diverse impacts on forests, sometimes beneficial, sometimes destructive. Rising consumer demand is however placing an unsustainable burden on forests and needs to be lessened if forest loss is to be curbed. Although timber extraction may not make economic sense if the long-term costs and benefits of all goods and services are factored in, the global economy is structured to exclude such externalities. Markets are volatile and often ephemeral, discouraging long-term investments in prudent resource use and encouraging short-term planning and "grab it and run tactics". Behind policies which have given undue emphasis to forest as sources of wood rather than other forest goods and services, lies the overwhelming pressure of the market.

High levels of consumption have been fuelled by low tariffs on timber and forest products, inadequate timber pricing, currency devaluation.

Regionally and globally, sustainable forest management will be impossible until the issue of excess consumption is addressed. To date, there is no evidence that European countries have the will to even discuss this issue, let alone confront it in an equitable way.

## Conclusion

Forests are different from other production systems : they grow slowly, they are land extensive, they supply environmental services and subsistence, and the number of stakeholders is high. They deserve special consideration from policy-makers and researchers.

Unfortunately, because of the reality of the underlying causes of deforestation and forest degradation, lying mainly outside the forests and forest sector, the flow of funds going directly into forests from European donors, for management and protection purposes, will continue to be rendered nil by investment in activities that may have damaging impacts on forests.

The fight against tropical forest destruction and degradation depends as much or even more upon political will than on technical issues. Foresters and scientists should move outside their traditional area of influence. They need to influence decisions in other sectors and ensure the mainstreaming of forest ecosystems concerns in European policy-making.

## NOTES AND REFERENCES

[1] Revised Forest Strategy of the World Bank Group, October 2002. The 15 member states of the EU contribute to over 26 % of the World Bank budget.

[2] Cited in "State of the World's Forests 2003", FAO, March 2003.

[3] Cameroon, Central African Republic, Gabon, Guinea-Bissau, Tanzania, Uganda.

[4] "Forests at the edge : a review of EC aid spending", FERN, December 2002, available at www.fern.org

[5] With the exception of Ireland, all EU member states have at least one ECA.

[6] See "Responsibility Abroad: How Export Credit Agencies Impact on Biodiversity", FERN Briefing Note, January 2003.

[7] See "Unusual Suspects: Unearthing the Shadowy of World Export Credit Agencies", Doug Norlen, Rory Cox and catriona Glazebrook, Pacific Environment and ECA Watch, 2002.

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# Report

by

François Malaisse *

This workshop, the third of three, is held in the premises of the "Palais des Académies" in Brussels, under the title of : "Tropical Forest and Industrial Society".

The workshop is opened by Prof. Y. Verhasselt, Permanent Secretary of the Academy, and by Dr. G. Demarée, President of the Academy and Director of the Section of Technical Sciences.

**E. Peeters** **, European Commission. — *Forêts tropicales et Commerce international.*

After recalling that Commerce GD is concerned with forests, the diversity of forest products at world level is reminded.

Developed countries consume two thirds of wood production ; this implies interregion fluxes, besides heavy supply for firewood. Some regional specializations of the types of forest products are obvious ; moreover the increase of Asia (namely China) needs are evident.

Prices are globally diminishing, little elasticity of prices is noted.

Import of tropical wood decreases in Europe, as a result of the bad image spread by NGOs.

European commercial policy is engaged at three main levels, namely : (a) commercial negotiations, (b) promotion of sustainability (sustainable certification concerns 8 % of tropics), and (c) fight against illegal exploitations (corruption, governance, etc.).

A FFUN (Forest forum of U.N.) is scheduled. New perspectives are arising from (a) plantations in Southeast Asia and South America,

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(b) gained interest in forest certification, and (c) stronger links between private and public sectors.

The discussion is about the participation of local population in governance of "social forests", the restriction of the number of species involved for plantation (biodiversity), local land use regarding forest plantations as well as illegality according to national rules.

**B. Muraille,** FERN (Forest and the European Union Resources Network). — *Europe and the World's Forests.*

In her introduction, the speaker first recalls that we are now facing the same problems as ten years ago ! Indeed the world's tropical forest continues to disappear with disheartening speed.

Secondly, Europe remains a major force by contributing to deforestation ; the poor acting as agents rather than causes of forest destruction. Thirdly, there are some contradictions ; for example, the EC provides funds to offer logging facilities, other aids are linked to an adverse impact on forest.

The World Bank policy is reviewed. The following trends are underlined :

— EU contributes to 26 % of World Bank budget ;
— Revised forest strategy (2002) allows plantations to be established in tropical forests ;
— EC aids are provided in order to improve access to markets, including aids (2002-2007) for road building in highly forestry countries (facilitating traffic of illegally or unsustainably logged timber).

Moreover, the economic policies encourage deregulation in export-oriented production. Namely, as far as trade is concerned, (a) low tariffs encourage consumption, (b) exports are now twice the 1970 values. The global trade in quality timber as well as the increasing production of paper pulp are major forces opening up forest to other interests.

Concerning investment, the case of ECAs is presented and commented. Last decade implied trade liberalization. Several examples of problems are discussed such as (a) gas production in a Peruvian "hot spot" diversity site, as well as (b) pulp and paper production in Indonesia.

Finally the speaker comments on markets and consumption, stating that (a) the global *per capita* consumption has increased by 3 % a year$^{-1}$ since 1970, (b) the surplus of wood consumption is not tackled by European countries.

In conclusion, the particular characteristics of forest ecosystems' production are underlined and their consequence "Fighting tropical forest destruction" is a fine task! But it is partly undermined by Europeans donors. We need **society and individual choices for the future**.

## General discussion

Several points are discussed, including impact of road opening, illegal exploitation aspects, incompatibility agriculture > < forest, need for applied research.

## Closing debate

*Aim* : determination of topics in view of the International Symposium on Tropical Forests.

The following problems have been mentioned or discussed during the closing debate, first with the formulation of major themes :

— Monitoring the Evolution of the Tropical Forest Area ;
— Sustainable Management of Tropical Forests ;
— Tropical Forest and Industrial Society.

Attention should be given to:

— Conservation, use and biodiversity (three levels).
— Topics to be arranged either in a (chrono)logical order or according to a priority order; economic aspects have to be taken into account at all levels.
— Land use
  — Reasons (basic causes) for deforestation ;
  — Types (typology) of forest ;
  — Better use of research results for sustainable management (present small place in market policy).

Finally more attention will be paid to :

— Standardization of forest data ;
— Better Belgian tropical forest policy ;
— Actions that have to be taken with interested governments (where Belgium is present or (and) interested).