

Promoting Reduced-Impact Logging in Tropical Developing Countries: A Success Story of Technology Transfer

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Abstract

Industrial timber harvesting operations commonly employ heavy machinery and thus have the potential to inflict significant damage on soils, streams, and residual vegetation. Impacts associated with such operations have been especially troubling in many tropical countries, where mature trees often have large crowns capable of destroying other trees when they fall; soils remain wet for much of the year and are highly susceptible to significant compaction and erosion; loggers typically have little education, are poorly trained, and often must work and live in arduous, unhealthy conditions; and remote locations make oversight by government agencies difficult. Beginning in the early 1990s, the Food and Agriculture Organization of the United Nations (FAO) launched a concerted effort to develop and promote codes of forest harvesting practice that would provide guidelines for planning and controlling logging operations in tropical forests in order to reduce environmental impacts. This effort included research to define and validate reduced-impact logging practices and technologies; publication and distribution of a "model" code of forest harvesting practices; development and promotion of regional codes of practice; and provision of technical assistance to individual countries to develop and implement national codes of practice. Although FAO provided the initial stimulus for the effort and has remained a central player, much of the work has been done by a wide

variety of research institutes and universities; nongovernmental organizations; industry associations; government technical-assistance programs; and international agencies such as the International Tropical Timber Organization, the International Labor Organization, and the World Bank. This paper provides an overview of this global effort and suggests reasons it has been successful in transferring knowledge and technology from industrialized countries to tropical developing countries.

Keywords: Reduced-impact logging, code of forest harvesting practice, environmental impacts.

Introduction

Over a period of several years leading up to the United Nations Conference on Environment and Development (UNCED), which was held in Rio de Janeiro, Brazil, in June 1992, the Forestry Department of the Food and Agriculture Organization of the United Nations (FAO), based in Rome, Italy, began work on programs designed to recognize the connection between environmental protection and sustainable economic development of poor countries. The UNCED was an enormously important conference, involving official delegates from 178 countries, heads of state of more than 100 countries, a large number of delegates from UN agencies and related organizations such as the World Bank, and representatives of more than a thousand nongovernmental organizations (NGOs). Hundreds of journalists covered the 12-day summit, both for television and for print media, and as a result it was front-page news around the world. A collection of international documents and agreements that resulted from the conference is accessible online from Columbia University's Center for International Earth Science Network (CIESIN 2005).

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The FAO was involved in UNCED at every level, from the political to the operational. Beginning around 1990, each operating unit within FAO was encouraged to develop a program of work consistent with the ideas that were to be raised at UNCED. As part of this planning process, the Forest Harvesting and Transport Branch, a small unit of the FAO Forest Products Division, proposed a program of work entitled "Environmentally Sound Harvesting in Tropical Forests." The proposal was accepted in 1991. I was hired, first on a consulting basis during the summer of 1991 and then as a full-time forestry officer in early 1992, to implement the program together with Branch Chief Rudolf Heinrich, an Austrian forest engineer who at that time was already a 20-year veteran of FAO. The program is described in Dykstra and Heinrich (1992).

This paper provides an historical overview of an effort to promote what began as "environmentally sound forest harvesting" and has now become commonly known throughout the tropics as "reduced-impact logging," or RIL. The paper considers some of the reasons the effort has been successful and also examines missteps that might easily have consigned it to the dustbin of international forest history.

Tropical Forests

Foresters have recognized for 150 years or longer that tropical forests are fundamentally different in many ways from temperate forests (Brandis 1897). Among other things:

- Tropical forests commonly exhibit an extraordinarily high degree of speciation—that is, many tree species are often present on each hectare of forest and the management requirements for these species (or for cohorts of species) may differ markedly. By comparison, temperate forests usually have a relatively small number of tree species per hectare, many of which will respond in similar ways to a given management regime.
- Most natural forests in the tropics have only a few trees per hectare that reach commercial size and are of species that can be utilized profitably by the timber industry. Temperate forests, on the other hand, often have many stems of commercial trees per hectare. The difference is significant—as much as two orders of magnitude or more.
- The volume of commercial timber that can be harvested from each hectare of tropical forest is usually much lower than in temperate forests, often by one or two orders of magnitude. This makes logging operations in tropical forests much more expensive, per cubic meter of timber harvested, than similar operations in temperate forests.
- Mature trees in tropical forests often have large, heavy crowns that are capable of destroying or severely damaging other trees when they are felled. To some extent this is also true in temperate forests, especially those dominated by broadleaved tree species. Typically, however, tree crowns spread more broadly in tropical forests, and because they are often interconnected by strong vines, felling one tree may cause several adjacent trees to be pulled over or broken in what tropical foresters refer to as a "domino effect."
- Tropical forests are commonly inhabited by people. Many of these people, whose number is estimated to be around 1.6 billion, rely heavily on forest resources for their livelihoods. In some cases, these forest-dependent people may be recent migrants attempting to escape civil war, social unrest, or hoping to find land that can be cultivated. In other cases, they are indigenous people whose families may have lived within the forest area for generations. In either case, sustainable development as defined by UNCED requires that these people and their welfare be explicitly considered in forest management.

Reduced-Impact Logging as Silviculture

Logging by itself is not silviculture, just as silviculture by itself is not forest management. Nevertheless, logging is an essential part of both silviculture and forest management, and is one of the most important tools available to forest managers for influencing stand conditions. By the mid-1800s, Brandis (1897) had recognized the importance of careful logging as a component of silviculture. In Burma and later in India, he promoted the use of elephants over bullocks or horses for skidding, arguing that the elephants' large, padded feet minimized soil disturbance and compaction.

Following the end of World War II, mechanized logging equipment was introduced into tropical forests on a large scale. Within a few years, tropical foresters began reporting extensive damage to residual vegetation and soils as a result of these logging operations (e.g., Redhead 1960). These problems were partly attributed to the higher rates of production associated with the use of heavy machinery, but also to the fact that the people operating the machinery tended to be poorly trained and have no understanding of silvicultural requirements or the need for environmental protection.

In reviewing assessments on logging damage, one influential tropical forester (Dawkins 1958) went so far as to suggest that mechanized harvesting might be incompatible with the selection harvesting systems practiced in many parts of the tropics. Others, recognizing the impracticality of returning to the labor-intensive systems of earlier years, have focused on promoting technologies and practices that would permit the use of mechanized harvesting systems while reducing environmental impacts to a level compatible with sustainable forest management (e.g., Dykstra 2004, Dykstra and Heinrich 1992, Hendrisen 1989, Marn and Jonkers 1982). These methods and technologies have now become widely known as "reduced-impact logging," or RIL. There is no single, globally applicable definition of what constitutes RIL because many of the specific procedures, environmental

standards, and types of logging equipment differ with local conditions. Nevertheless a RIL operation in tropical forests would normally include the following:

- Preharvest inventory and mapping of individual crop trees.
- Preparation of accurate, operational maps for all harvest areas.
- Cutting of vines where necessary in advance of felling operations.
- Planning, design, and construction of roads, skidtrails, and landings to provide access to the harvest area and to the individual trees to be harvested while minimizing soil disturbance and protecting streams and waterways with properly engineered crossings.
- Use of directional felling and bucking of logs in a way that optimizes value recovery.
- Winching of logs to skidtrails rather than driving the skidding machine to each log; limiting the operation of heavy equipment to skidtrails.
- When necessary because of soil conditions and topography, utilizing yarding systems that suspend logs partially or fully above the ground.
- Conducting postharvest assessments to provide feedback to the timber concession holder and logging crews, and to evaluate the degree to which RIL guidelines were followed.

Results: Adopting Reduced-Impact Logging

Although no one would claim that all or even a majority of logging operations in tropical forests now meet the standards of reduced-impact logging, an impressive amount of progress has been achieved in the relatively short time of about 15 years. A recent report by the International Tropical Timber Organization, for example, found that a "sea change" had occurred in the attitudes of timber companies in the Brazilian Amazon toward the adoption of RIL technologies (ITTO 2003). Whereas the general attitude had been very negative 5 years earlier,

by 2003 a large number of companies had adopted RIL practices and were hiring foresters to supervise their logging operations. Even in industrialized countries, RIL is becoming recognized as a specific requirement of forest management; as an example, in a recent survey, 89 percent of logging operators rated training in RIL technologies as a medium- or high-priority need because of landowner demand (Egan 2005).

What Is Driving the Adoption of Reduced-Impact Logging?

The global effort to promote the use of RIL technologies in tropical forests arguably began with UNCED in 1992, although similar efforts had been attempted earlier. UNCED's strong focus on the problem of tropical deforestation resulted in a significant effort over a wide array of fronts to improve industrial forestry operations in the tropics. Table 1 provides a chronology of events that I consider to have been instrumental in promoting the adoption of RIL. Several factors were especially important:

- Adoption of the term "reduced-impact logging," to replace terms that had been used previously but were not as widely accepted such as "environmentally sound harvesting." In particular, "reduced-impact logging" resonated positively with environmental advocacy groups, which were more willing to accept the idea that logging impacts can be reduced than they were to acknowledge that logging could ever be considered "environmentally sound." It isn't certain who invented this term, but it was first popularized by Putz and Pinard (1993) in reference to a carbon-sequestration project put together by Jones (1995).
- Publication of the *FAO Model Code of Forest Harvesting Practice* (Dykstra and Heinrich 1996) in English, French, Spanish, and most recently in Chinese. This publication has been enormously influential in developing countries because of consistent, long-term support by FAO. Prior to its publication, there was some resistance within the

FAO Forest Products Division to the concept of such a document. These objections were overridden by David Harcharik, who at that time was head of the FAO Forestry Department. Later the Director-General of FAO, Jacques Diouf, during his declaration at the 2002 World Summit on Sustainable Development in South Africa (Diouf 2002), explicitly identified the FAO Model Code as an example of a policy initiative that has been extraordinarily effective in promoting sustainable development. At least 40 countries have now developed national codes or guidelines based on the FAO Model Code. The FAO has since published more detailed regional codes of forest harvesting practice for Asia (FAO 1999) and Africa (FAO 2003) and is currently working on a regional code of forest harvesting practice for Latin America. The FAO has also published a series of "Forest Harvesting Case Studies" that have been influential in convincing tropical foresters of the value of RIL, and together with the USDA Forest Service and United States Agency for International Development (USAID), FAO has supported development of software that permits operators to rapidly conduct financial analyses of RIL as compared to conventional logging (Dykstra 2004).

- Complementary efforts by other international organizations, especially the International Tropical Timber Organization (ITTO), the International Labor Organization, and the World Bank, have contributed to the adoption of RIL and to its political acceptance among tropical countries. The ITTO in particular has been active in supporting projects to implement and evaluate RIL operations throughout the tropics.
- Efforts by regional organizations such as the Asia-Pacific Forestry Commission (APFC) to promote sustainable forestry practices and the adoption of RIL. The APFC in particular has been very active, with a strong program promoting the development of regional and national codes of forest harvesting

Table 1—Chronology of events related to the publication of the Food and Agriculture Organization Model Code of Forest Harvesting Practice and broad acceptance of reduced-impact logging in the tropics

Year	Event
1990	Fiji National Code of Logging Practice published with the assistance of the International Labor Organization.
1992	Food and Agriculture Organization (FAO) Program on Environmentally Sound Forest Harvesting initiated (Dykstra and Heinrich 1992). IUFRO conference on harvesting and silviculture held in Malaysia (Wan Razali et al. 1994).
1993	Discussion on reduced-impact logging (RIL) with U.S. representative to COFO, FAO's Committee on Forestry, which meets every 2 years; the representative indicated that the U.S. delegation could not support any resolution involving the words "harvesting" or "logging" due to sensitivities in the U.S. Congress. Austrian and Indonesian representatives to COFO jointly introduce a motion directing FAO to develop codes of forest harvesting practice relating to tropical forests. Sabah Foundation RIL project started (Jones 1995, Putz and Pinard 1993). The Tropical Forest Foundation (TFF) initiated its project on low-impact logging research and training in Pará, Brazil. This would eventually lead to publication of a comprehensive financial analysis of RIL (Holmes et al. 2000).
1994	Workshop on the STREK Project (Silvicultural Techniques for the Regeneration of logged-over forest in East Kalimantan), which was initiated in 1989 by CIRAD-Forêt (France) and the Indonesian Ministry of Forestry, held to review relationships between RIL and silvicultural practices. Draft of the <i>FAO Model Code of Forest Harvesting Practice</i> produced (Dykstra 1994) in spite of opposition within the FAO Forest Products Division. Two workshops were held to review the draft, in the Philippines and in Germany.
1995	Preliminary release version of FAO Model Code introduced at COFO by David Harcharik, newly appointed head of the Forestry Department at FAO, in spite of continued opposition within the Forest Products Division. Publication of the document was approved by COFO delegates. <i>Code of Conduct for Logging of Indigenous Forests in Selected South Pacific Countries</i> endorsed by the 26 th meeting of the Asia-Pacific Forum (SPFDP 1995). FAO satellite meeting held at the IUFRO World Congress in Tampere, Finland (FAO 1997).
1996	FAO Model Code published (Dykstra and Heinrich 1996) in English, French, and Spanish. All versions are available both in print and online. RIL conference for Southeast Asia held in Sandakan, Sabah, Malaysia. Asia-Pacific Forestry Commission formation of an ad-hoc working group to develop a Code of Practice for Forest Harvesting in Asia-Pacific.
1997	First national code of practice known to be based on the FAO Model Code published in Guyana. IUFRO interdivisional conference on RIL hosted by the Bolivian Forestry Project sponsored by the U.S. Agency for International Development (BOLFOR) in Bolivia.

Table 1—Chronology of events related to the publication of the Food and Agriculture Organization Model Code of Forest Harvesting Practice and broad acceptance of reduced-impact logging in the tropics (continued)

Year	Event
1999	<i>Regional Code of Practice for Forest Harvesting in Asia and the Pacific</i> published (FAO 1999).
2000	Chinese translation of the FAO Model Code (Dykstra and Heinrich 1996) published by FAO. Special issue of the International Forestry Review dedicated to RIL (Commonwealth Forestry Association 2000).
2001	International conference on applying RIL held in Kuching, Sarawak, and Malaysia (Enters et al. 2002). RIL guidelines published for Indonesia (Elias et al. 2001).
2002	Draft national code of forest practice published in China with support from FAO and ILO. FAO Declaration at the World Summit on Sustainable Development, Johannesburg (Diouf 2002).
2003	International conference on codes of forest practice held in Japan (Japan Forestry Agency 2003). <i>Regional Code of Practice for Forest Harvesting in Africa</i> published in French (FAO 2003).
2002-2004	A financial-analysis software package, RILSIM, was developed and promoted by the USDA Forest Service, United States Agency for International Development (USAID), FAO, and the Asia-Pacific Forestry Commission (APFC) as a means of encouraging loggers in developing countries to adopt RIL methods (Dykstra 2004).
2005	According to FAO, at least 40 countries have used the FAO Model Code as a model in developing their own national codes of practice or guidelines related to forest harvesting.

practice; an information-sharing network (RILNET); the organization of international conferences on RIL and on sustainable forest management; a comprehensive program of training and awareness; and support for the development of tools to promote RIL, including the RILSIM software mentioned previously.

- Work by research institutions such as the Center for International Forestry Research, the French tropical forestry research organization CIRAD-Forêt, the Tropenbos Foundation of the Netherlands, and many national research agencies and universities in developing countries has legitimized RIL as a focus of research and development efforts.
- Development of practical, field-oriented training programs on RIL methods and technologies, most notably by the U.S.-based Tropical Forest Foundation (TFF) and its Brazilian subsidiary, Fundação Floresta Tropical (FFT), has been essential for promoting adoption of RIL. The TFF has now launched similar regional training programs for Africa and Asia.
- Implementation of projects to promote adoption of RIL by donor agencies for both multilateral and bilateral development-assistance programs such as Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) (Germany), USAID (United States), Japan International Cooperation Agency (JICA) (Japan), Department for International Development (DFID) (United Kingdom), Canadian International Development Agency (CIDA) (Canada), Swedish International Development Cooperation Agency (SIDA) (Sweden), and others.
- Active promotion of RIL by international environmental organizations such as the Worldwide Fund for Nature, IUCN (the World Conservation Union), the Wildlife Conservation Society, and Greenpeace; and by influential nongovernmental organizations

in tropical countries such as IMAZON (the Institute for Man and Nature) in Brazil and Forest Watch in Indonesia.

- Adoption of RIL as a requirement for certification of sustainably managed forests under the standards and guidelines of the Forest Stewardship Council, with similar requirements either explicitly stated or implied in other certification programs.
- Acceptance of RIL by influential industry organizations such as the Sarawak Timber Association in Malaysia and the Association of Timber Concession Holders in Indonesia; AIMEX (the Association of Timber Exporting Industries of the State of Pará) in Brazil; and the African Timber Organization and ATIBT (Association Technique Internationale des Bois Tropicaux) in Africa.
- Support for RIL concepts by government agencies in developing countries that have major areas of tropical forest. Of particular note in this regard are the governments of Indonesia, Malaysia, China, Fiji, Ghana, Congo, Gabon, Guyana, Bolivia, and Brazil, although many other countries have also endorsed the concept of RIL.

Concluding Remarks

Reduced-impact logging is clearly a concept whose time has come, at least for tropical forests. For the most part, RIL itself is not new; most of these technologies and practices have been developed in temperate forests and are used there as a matter of course, or as a result of forest practice laws that require them. The rapid rate at which RIL is being adopted in tropical forests, therefore, can be considered a success story in the transfer of technology from industrialized countries to developing countries. It's important to recognize that this success cannot be attributed to any single person, organization, or event, but rather to a combination of events, evolving public attitudes about forests, and an informal (and to some extent even unwitting) consortium of organizations and individuals.

I consider five complementary factors to have been particularly important in facilitating the widespread adoption of RIL practices in the tropics:

Champions. Since its introduction in the early 1990s, RIL has had numerous champions, both among individuals and among organizations. These champions represent a wide variety of viewpoints, from industrial forestry to conservation advocacy. Although they might disagree on many policy issues, the champions agree on the importance of RIL for the future of tropical forests, and as a result their combined voice has been very strong.

Policy support. The strong support of RIL by the major international development-assistance organizations, especially FAO, ITTO, and the World Bank, coupled with equally strong support from influential environmental organizations such as World Wildlife Fund (WWF), Wildlife Conservation Society (WCS), and IUCN, has led to very broad support at the ministerial level in a majority of countries where tropical forests represent a major resource.

Forest certification. By requiring the adoption of RIL as an essential prerequisite for certification of forests as being sustainably managed, certification bodies have provided a strong incentive to timber companies interested in selling forest products in markets that require certification. This has been cited as a major reason for widespread adoption of RIL in the Brazilian Amazon (ITTO 2003).

Training. Innovative approaches to on-the-ground training in RIL technologies and practices as developed by the Tropical Forest Foundation and by a variety of specialized consulting companies have been essential in getting RIL actually implemented. Many of these efforts have been supported financially by development-assistance organizations, particularly ITTO and the World Bank, as well as by bilateral aid agencies.

Lack of controversy. Although there has inevitably been some resistance to the promotion of RIL among

advocacy groups that consider any logging in tropical forests to be unacceptable, by and large it has been surprisingly free of controversy. This has encouraged more rapid adoption by loggers than would have been the case if the concept of RIL itself had been controversial.

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