TRIP TO THE AMAZON, BRAZIL

G.V. Wellburn, P.Eng., R.P.F.

SR-72

FOREST ENGINEERING RESEARCH INSTITUTE OF CANADA
Western Division
2601 East Mall
Vancouver, B.C.
V6T 1W5 (604) 228-155

FERIC Special Report No. SR-72

September 1990

KEYWORDS: Brazil, Amazon River Region, Forestry projects, Planning, Forest depletion, Agriculture, Land use, Zoning, Forest inventories, Soil classification.

© Copyright 1990, Forest Engineering Research Institute of Canada ISSN 0381-7733

Abstract

A study tour was taken by Rudolph Heinrich, Chief of the Harvesting and Transport Branch of the timber division of the Food and Agriculture Organization of the United Nations (FAO) and Vern Wellburn of the Forest Engineering Research Institute of Canada (FERIC) to establish contact and discuss potential forestry projects in the Amazon region. The trip was taken in the spring of 1990. The major cause of the deterioration of Brazil's tropical rain forest is the clearing of forest by the poor farmers who are moving into the Amazon region in search of agricultural land. Because less than 10% of the region will support sustainable agriculture, and because the farmers lack technical training, they damage nonagricultural land in their search. Commercial forestry has been a minor cause of forest deterioration and potential exists for an expanded sustainable forest industry. Forest deterioration could be reduced by improved soil and forest inventories, zoning, and land-use planning. FAO and Canada can assist Brazil in reducing the problem.

Author

Vern Wellburn is a Forest Engineering graduate of the University of British Columbia. He held various positions in the Coastal British Columbia logging industry before joining the University of British Columbia Faculty of Forestry as a special lecturer in 1971. In 1975 he joined FERIC as the Manager of the Western Division, and was appointed Vice-President of FERIC in 1985.

Disclaimer

This report is published solely to disseminate information to FERIC members. It is not intended as an endorsement or approval by FERIC of any product or service to the exclusion of others that may be suitable.

Table of Contents

Abstract	ii
Author	ii
Summary	v
INTRODUCTION	1
BACKGROUND	1
Geography	1
History	1
Education	3
AMAZON REGION	3
Development	3
Zoning and Land Use	4
Agro-Forestry	4
Tapajos Research Forest	5
Sawmills, Log Export, and Value Added	5
Jari—Monoculture	5
Greenhouse Effect and the Amazon	6
Conferences	6
Objectives of Land Management in the Amazon Region	7
Recommendations	7
Conclusions	7

List of Figures

1 Map of Brazil	2

Summary

This is a report on a study tour taken by Rudolph Heinrich, Chief of Harvesting and Transport Branch of the timber division of the Food and Agriculture Organization of the United Nations (FAO) and Vern Wellburn of the Forest Engineering Research Institute of Canada (FERIC) to establish contacts and discuss potential forestry projects in the Amazon region. The trip was taken in the spring of 1990. Visits included discussions with senior government officials in Brazilia, tours of forest research centres in Belém, Santarem, and Manaus, and three field trips. The report contains a brief overview of Brazil and the Amazon, a discussion of the problems leading to the deterioration of the tropical rain forest, and recommendations for reducing the problems.

Most of the industry in Brazil is concentrated in the area around and south of Rio de Janeiro. The northeast coast is dry and the people are poor. The Amazon is mostly untouched and sparsely populated. Following the construction of the Trans-Brazilian highway in the 1960s and 1970s, poor farmers began to move north in search of land. Because less than 10% of the Amazon region will support sustainable agriculture and because the forest and soils are not uniform, the farmers damage non-agricultural land in their search for better farm land. Beef is the major cash crop, and 90% of the forest burned in the past 20 years has been for the purpose of obtaining ranch land for cattle.

FAO has embarked on a zoning project to classify the Amazon into biogeoclimatic zones. This will serve as the basis for rational land-use planning.

Commercial forestry in the Amazon is limited and does not pose an environmental threat. The government has recently banned the export of whole logs and is encouraging sawmills to produce and market higher value products. The only pulp mill in the Amazon, at Jari, is operating. There appear to be opportunities to expand the sawmilling and pulp and paper industries. Pulpwood could come from plantations or from natural forests.

Some of the steps that can be taken to reduce the deterioration of the Amazon forests include:

1. Complete the overall zoning program and intensify it near highways and populated areas.
2. Develop land-use criteria, train agricultural and forest technicians and provide an extension service for farmers and forest operations.
3. Increase agricultural and agro-forestry research to develop economical, sustainable crops.
4. Conduct multidisciplinary logging and silvicultural studies to develop improved systems and prescriptions for different biogeoclimatic zones.
5. Encourage further development of the forest industry to provide wealth and employment and reduce the necessity for subsistence agriculture.

FAO and the developed countries can assist Brazil in introducing improved methods and training its agricultural and forestry people. Canada has much to offer Brazil because of its knowledge of agriculture and forestry and ongoing experience in land-use planning and development. The Amazon has a vast reservoir of commercial wood and fibre. Opportunities may exist for joint ventures with Canadian forest companies in sawmills, plywood, and pulp and paper.

INTRODUCTION

From March 26 to April 8, 1990, I accompanied Rudolph Heinrich, chief of the harvesting and transport branch of the timber division of the Food and Agriculture Organization of the United Nations (FAO) on a trip to Brazil. The objective of the trip was to establish contacts and discuss potential FAO forestry projects in the Amazon region. My reason for participating was out of curiosity and for personal education. I hope that my observations and this report may assist Canada and Canadian foresters in defining a role to reduce the deterioration of Brazil's tropical rain forest.

The time of our visit was interesting, but inopportune. Brazil had elected a new government on March 15, 1990. In an effort to stop inflation, which ran at 84% during February, the new government froze all Brazilian citizens' personal bank accounts within the country. The government also announced an internal reorganization which could eliminate whole departments and reduce the civil service by 25%. The immediate impact was that Brazilians had no money to spend on anything but essentials, business suffered, and the exchange rate was chaotic. On March 20, the U.S. exchange rate was 70 Cruzeiros to $1.00 U.S.; on March 22 the rate was 30 Cr$ to $1.00 U.S. The government tried to stabilize it at 45. From a tourist's point of view, 60-70 Cr$/$1.00 would be fair. At 45, hotels and food were very expensive.

In spite of this crisis, we were able to maintain our schedule. In the capital Brazilia we visited Dr. Carlos Magna, President of EMBRAPA, the Agriculture and Forestry Research Department; Dr. Jose Carlos Carratho, Director of IBAMA, the Brazil Forest Service; and Mr. Rosenecker, FAO representative in Brazil. We also visited the Canadian embassy and talked to the Ambassador, John Bell, and the CIDA (Canadian International Development Agency) representative, Mr. Normand Asselin.

In additional to Brazilia, we visited Belém, Santarem, and Manaus where we toured four research institutes, several sawmills, and made three field trips to observe forest operations and land-use practices (see Figure 1). Wet weather prevented us from reaching any logging operations. Also, the economic crisis disrupted plane schedules, so we were unable to visit Jari, the location of the only pulp mill in the Amazon region.

In this report I will:

- provide a general overview of Brazil and the Amazon region to establish a perspective for consideration of its forestry problems and solutions; and
- recommend potential projects for FAO, CIDA, FERIC, and Canadian forestry consultants.

BACKGROUND

Geography

Brazil is a large country—larger than the continental United States—with a population of 140 million. Forty-three percent of the population and sixty-three percent of industry are concentrated in the area around and south of Rio de Janeiro. The northeast coast is also heavily populated, but the climate is dry and the people are poor. The central plateau, which slopes downward towards the north and Amazon river, is sparsely populated. The plateau is drier in the south and gradually becomes wetter and more heavily forested in the north. The Amazon forest covers 42% of the area of Brazil and is inhabited by approximately 14 million people.

History

Pedro Cabral from Portugal landed in Brazil in 1500. By 1531, the Portuguese had established settlements to trade wood and dyes with the Indians. The coast of Brazil was found to be ideal for growing sugar cane, and for 300 years sugar was the main commercial enterprise. Indian and African slaves were used for labour on the plantations. Between 1550 and 1850, approximately 3.5 million African slaves were shipped to Brazil.

Gold was discovered inland from Rio de Janeiro in 1690. This led to the exploration of the country's interior and a migration from the northeast coast to the south.

Most of the early Portuguese came as adventurers, eager to seek their fortune and then return home rather than stay as immigrants. As a consequence, few white women immigrated and the men mixed with the Indians and Africans to develop a unique Brazilian race.

In the 1800s, coffee grown on large plantations in the south replaced sugar as Brazil's main export. After slavery was abolished in the 1880s, European and Japanese farmers immigrated to work on the coffee plantations.

During its early days, Brazil was ruled by regional Portuguese governors who were strongly influenced by the Catholic church. In 1807, when Napoleon captured Lisbon, the Portuguese royal family fled to Brazil. After the Battle of Waterloo in 1815, the king returned to Portugal, but left his

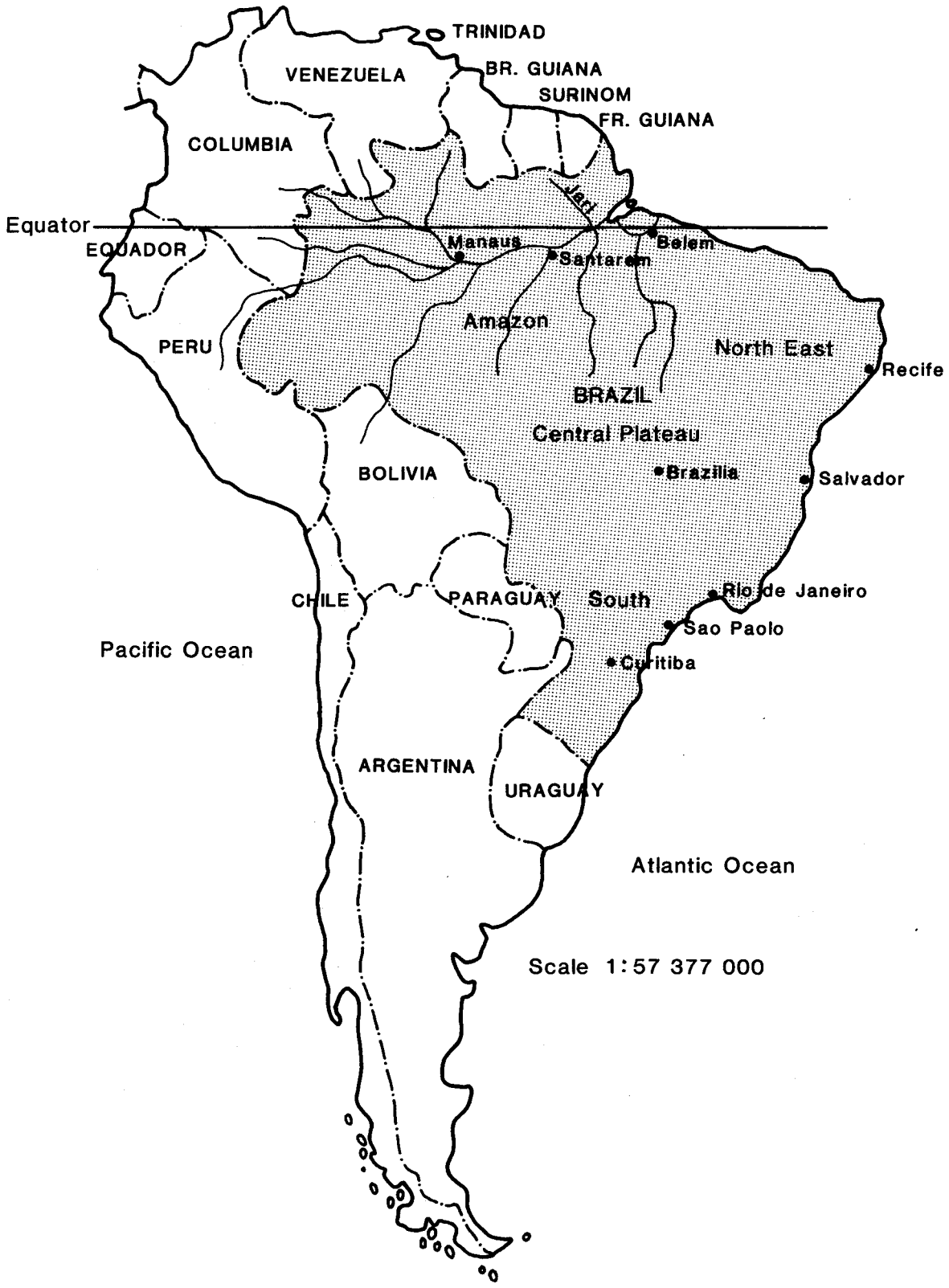

Figure 1. Map of Brazil.

son, Dom Pedro I, as prince regent. Dom Pedro united the country and in 1822 declared himself emperor of an independent Brazil.

In 1889, a military coup overthrew the emperor, Dom Pedro's son, and established a democratic republic in which only about two percent of the people were allowed to vote. In 1930, Getulio Vargas took over as a military dictator. His policies were similar to those of Italian dictator Benito Mussolini, founder of the Fascist movement. Vargas enacted reforms and established a network of state industrial corporations.

In 1956, Juscelino Kubitschek was elected president. He borrowed heavily, encouraged foreign investment in Brazil, and moved the political capital from Rio de Janeiro to the new city of Brazilia in the interior. But in 1964, the military once again took control and free elections were not held until the 1980s.

Currently, the economy of Brazil is in chaos because of inflation and debt. There is a great disparity in the wealth of people and regions. On the other hand, the country is heavily industrialized and self-sufficient in most products including automobiles, trucks, and appliances. The electric power and transportation utilities are efficient.

Education

Public education in Brazil is inadequate. Only 20% of the students complete elementary school. Most of the university students come from rich families who send their children to private schools. The lack of a strong middle class with an intermediate or technical education encourages instability and is a severe handicap to the development of industry and environmentally acceptable agriculture and forestry.

AMAZON REGION

The Amazon River is the world's largest. It not only drains most of Brazil, but also extends into many adjoining countries.

The Amazon region supports a tropical rain forest and is usually wet. Near the equator the dry period occurs in August and September, but it extends into October further south. The television scenes of continual burning are all taken during the few weeks a year when it is dry enough to burn.

The soil in the Amazon region is not homogenous. In each area visited, we observed red laterite clays, yellow clays, and sand. Many of the soils are of volcanic origin. Some areas are flooded for part of the year and others are drained. The areas that we observed had patchy forest cover, similar to that of the lower Fraser Valley in British Columbia, or in Eastern Ontario, rather than uniform cover like the North American Prairies or Boreal forest.

Development

In order to better understand the problems of the Amazon region, it is instructive to compare the colonization of western North America during the 1800s with Brazil today. Before 1850, for 200 years, Western Canada and the United States were populated by a few European fur traders who worked with the Indians. Cities like Winnipeg and St. Louis were built along the main transportation rivers. The construction of the railroads in the late 1800s provided access for large numbers of European farmers who were looking for agricultural land. Initially, they regarded the forest as an enemy, and, as a result, they burned and cleared large areas of land, some of it unsuitable for agriculture. It was not until the 1940s, that Western Canadian and Americans began serious land-use planning and forest management.

The Amazon also went through several hundred years of pioneering with a small number of Europeans working with native people. Brazil nuts, some valuable wood species, and natural rubber were collected mostly along rivers. Rubber collection reached boom proportions in the 1890s, then declined. Many of the "rubber people" resorted to subsistence agriculture. In 1942, when the Japanese captured the rubber plantations in southeast Asia, 150 000 people were brought into the Amazon from southern Brazil to collect rubber. This boom was over by 1950, but many of the people stayed.

The Trans-Brazilian highway, connecting the major cities in the Amazon with the south, was built during the 1960s and 1970s. Like Canadian railways, it provided access for poor farmers from the over-populated dry provinces of northeast Brazil to the farmlands. These people view the forest as the enemy; their objective is to obtain land for their crops and animals. So far, the migration has only affected the southern states of Matto Gross, Rondonia, and Acre. The main Amazon states of Amazonas and Para have not been seriously affected, but people are continuing to move north. The people moving into the Amazon are farmers in search of land. They are not like the native people in other tropical areas who have a traditional culture based on clearing a

forest area, cultivating crops until the soil is depleted, then shifting to a new area. Because less than 10% of the Amazon is suitable for permanent agriculture, and because this productive land is scattered throughout the whole area, it is very difficult for the immigrants to establish farms without causing damage to the rest of the forest. We were told that 7% of the Amazon region represents more than all the agricultural land of France, and feeds a population of more than twice the Canadian population.

Meat is a valuable cash crop, so many farmers are interested in cattle ranching. Government officials estimated that 70% of the forest burned in the past 20 years has been for cattle ranching. In order to combat this problem, the government has removed any assistance subsidies from immigrant cattle ranchers and the research institutes have developed new breeds of cattle that are better adapted to the tropical climate and forage. Agriculture field extension officers are attempting to get the ranchers to grow hay on these better lands and to combine forestry with ranching instead of moving into a virgin forest. Apparently, in some areas agro-forestry works well. The trees provide soil stability and shade for both the grass and cattle.

We were told by several research people that commercial timber harvesting does not pose a environmental threat provided that reasonable precautions are taken to prevent soil erosion and burning. In the wet climate, cutover areas regenerate naturally with trees and shrubs. If harvesting is followed by replanting of desired tree species, then the results will be beneficial to both the environment and the future forest.

Other major contributors to the destruction of forest land are hydro-electric dams, and cutting wood to produce charcoal for fuel for metal-smelting and brick and cement production. Brazil must import oil and has no large coal resources; therefore, hydro power is an important source of energy. The government has recently passed legislation requiring charcoal-using industries to rehabilitate their cutover lands. This situation is similar to what happened in Sweden 100 years ago. Companies like Storakopparberg originally obtained their land holdings to provide charcoal for their copper smelters. Their rehabilitated lands now support a pulp and paper industry.

Brazilian forestry officials are sensitive to world opinion of the Amazon's problems. They claim to have taken action to resolve issues and are making progress to halt the worst activities. Research has played a key role in identifying problems and finding solutions. Local forestry officials realize that they could use outside help, but they would rather exchange or trade information than receive aid. They also resent the intellectual dishonesty of people who have exaggerated the problems of the Amazon on world-wide television. Canadian officials in Brazil are embarrassed by Canadian programs.

Zoning and Land Use

FAO has embarked on a zoning project to classify the Amazon into biogeoclimatic zones. The new government is very interested in this project and wants preliminary results within one year. Much of the information already exists on a macro scale, so the project will consist of collecting and classifying. This project is an essential first step in the development of rational planning for the Amazon. The objective is to delineate the areas suitable for sustainable agriculture, agro-forestry, plantation forestry, and areas which should be preserved to protect endangered plants and animals.

The zoning will identify land with a potential for agriculture, hydro dams, or intensive forestry. In cases where it is deemed necessary to convert land to a higher economic use than the natural forests, then the government will attempt to ensure that all the valuable timber is harvested and that the inferior species are reserved for fuelwood or some other use.

The confusion over the difficulty in defining the criteria for "wise land use" was illustrated to us in Manaus. Dr. Schubart, Director of INPA, which is a government research insititute, showed us satellite infrared photos of an area south of Manaus taken in 1978 and again in 1988. The encroachment on the forest by the farmers, particularly along the main road, was striking. The next day, we had an opportunity to visit a village 40 km along this road. We observed a fenced, well-kept dairy farm, a poultry farm, fruit orchards, and a sugar-cane plantation. The dairy farmer was using manure to fertilize what appeared to be organic soil. What we had been led to believe was that forest destruction through shifting agriculture, turned out to be orderly colonization with sustainable agriculture.

Agro-Forestry

We visited a palm-oil plantation established by Dr. Clara Pandolpho in the 1960s. She is now director of the SUDAM Agriculture and Forest Research Institute in Belém. Nitrogen fixing legumes are grown under the palms to provide natural fertilizer. These plantations are now supporting several palm-

oil factories. Local farmers, who previously grew pepper and spices, have planted oil palms and have built cooperatively owned factories. Palm oil is used in margarine, cooking oils, and soap. Brazil supplies only 2% of the world market, so the potential for expansion of this industry is tremendous.

Tapajos Research Forest

The Tapajos Research Forest, 80 km south of Santarem, was established with the assistance of FAO in 1978. During our discussions, several different officials and researchers referred to this forest as a good example of research. The objective was to harvest 5000 ha by different methods which would be subjected to different silvicultural treatments at a rate of 1000 ha per year. The plan was ambitious and would have provided much-needed forestry information. Unfortunately, when we visited the area, we found that the project was little more than a proposal. The research sample plots which were established by an FAO team in 1978 and then left for the local people to administer, were overgrown and in disrepair. No new plots had been established, no experiments conducted, and the records were not up to date. In order to plan and improve forest practices in the Amazon region, the Brazilian government badly needs the information that would come from this type of project, but it seems that unless long-term funding and ongoing supervision is provided, little will happen.

As a matter of interest, the Tapajos forest is near Fordlandia where a rubber and research plantation was established by the Ford Motor Company in the 1920s. Ford was interested in developing its own supply of rubber for tires and in finding a substitute species for hickory wood spokes in car wheels. Ford abandoned the project during the Depression in the 1930s.

Sawmills, Log Export, and Value Added

Round-log export from Brazil was prohibited in 1987. The problem with exporting logs from a mixed forest is that the customers are familiar only with two or three species. Customers require these species in large quantities. This forces the exporter to cover vast areas looking for marketable trees. The short-term effect of this prohibition was to reduce logging activity and government stumpage revenues. However, sawmills have begun to cut lumber for export and are improving the utilization of both the forest and the logs. Some mills are doing an excellent job.

The local sawmill owner has seemingly more opportunity to market new species to export markets. We visited a sawmill in Santarem that was cutting lumber and manufacturing parquet flooring for export. The owner was already using 12 different species and expected to use more. He worked closely with the local forest-products laboratory and selected species with similar mechanical properties to those already with an established market. His grading standards and quality control were excellent. The final grading was based on colour, to separate the dark wood from the light. All the lumber was kiln dried and the final product was wrapped in plastic for protection during shipping in containers. The owner claimed to be successful and stressed the importance of quality control, on-time delivery, and maintaining good and ongoing customer relationships.

We also visited sawmills cutting lumber for local use. These mills were inefficient and wasteful. The logs were left in the sun to check and the lumber was poorly sawn to no obvious standard. One owner said he was getting 40% recovery (40 m^3 of lumber for each 100 m^3 of logs processed). The owner of the export mill mentioned above claimed to be getting over 60%.

A comparison of Brazil today with the development of the lumber industry in Coastal British Columbia is interesting. During the early part of this century, the Western Canadian industry was relatively primitive. It supplied railroad ties and lumber for local use. In order to compete in the American market, the British Columbia Lumber Manufacturers Association established grading standards and the Pacific Lumber Inspection Bureau certified shipment. Training courses were established for sawmill workers and inspectors. During the 1930s, H.R. MacMillan formed an export company to buy lumber from independent sawmills for shipment to Europe and Australia. In addition, the Koerner brothers developed a market for the little-used species, hemlock, by calling it Alaska Pine.

The Brazil lumber and plywood industry needs grading standards, certified inspection procedures, and entrepreneurs to develop markets and promote the use of more species.

Jari—Monoculture

We were unable to visit Jari where the American entrepreneur, Daniel Ludwig, built a pulp mill in the 1970s. The mill was taken over by the Brazilian government in the 1980s. This project has been the source of a great deal of speculation by foresters, environmentalists, and the forest industry

throughout the world. It is one of the few pulpmills operating in a tropical rain forest. It gets its wood from tree plantations which were established by clearing the natural forests. We were told that the mill is running and the company was profitable in 1989. The Caribbean pine and eucalyptus plantations are growing well and being expanded. The gmilina did not do well and is being phased out.

Any discussion of Jari always raises the issues of monocultures. Monocultures are feared because they are considered unnatural and because some disease or pest could destroy the whole plantation. These fears are based on examples in forestry and agriculture where entire crops have been wiped out. For example, the mountain pine beetle has ravaged the natural monoculture of lodgepole pine in British Columbia. On the other hand, there are many examples of successful monoculture—the pine and eucalyptus stands of southern Brazil, and the pine stands in New Zealand.

It is not necessary for plantations in Brazil to be monocultures. It is estimated that the Amazon region contains two million different species of plants and animals. Of these, 240 are species of trees which will grow to more than 10 cm in diameter. Surely, it should be possible to choose 10 or more species with commercial value so that mixed stands can be established. INPA in Manaus is studying this possibility.

The Jari project should be viewed by foresters as an experiment to learn the results of utilizing the rain forest. It is the first pulpmill established in the Amazon region. Plantations could grow large amounts of wood. Not only may it be possible to establish more environmentally acceptable mills supplied by plantations, but pulpmills to use sawmill waste and low-quality tree species are badly needed. Utilizing waste wood would reduce the necessity for burning standing forests.

Greenhouse Effect and the Amazon

Dr. Mario Dantas, a graduate of the University of Florida, works in Belém for EMBRAPA on cattle research. He has written several papers on the greenhouse effect. Generally, his findings agree with those of Dr. Jim McTaggart-Cowan, director of the environmental service in Ottawa. Some of the findings are:

1. The mature, untouched forest which covers most of the Amazon is neutral. Since there is no net growth, the stands are not producing or using either oxygen or carbon dioxide.
2. When the forest is burned, approximately 30% of the carbon stored in the trees is immediately converted in carbon dioxide and released into the atmosphere. The remaining 70% of the carbon remains in the charred wood and dead trees. It will be released later as the wood decays. Because the Amazon region is wet, after burning it rapidly becomes green with brush and young trees and either recaptures carbon dioxide from the atmosphere or becomes neutral.
3. The oxygen used in the formation of carbon dioxide or produced by growing forests is insignificant.
4. During the past 20 years, approximately 25 million ha of Amazon forest have been burned.
5. Approximately half of the area burned by cattle farmers will support sustainable agriculture and the Brazilian government is successfully encouraging ranchers to farm the already cleared land rather than burn new forests.
6. Logging without burning may be beneficial to the world's atmosphere if mature forests are replaced by healthy growing forests. Silvopastoral systems—integrated crop trees and pasture—have great potential. These systems provide agronomic (soil), economic, ecologic, and sociologic benefit and maintain a healthy atmosphere.

Researchers like Dr. Dantos know what should be done to reduce the burning of the forest, but they admit that the problem is increasing. What is needed to make changes happen is workable, enforceable regulations and field extension workers to assist the farmers.

Conferences

It seemed that everywhere we went, we saw notices of environmental conferences organized to discuss the problems of the Amazon region. Several of the scientists and officials mentioned that they were preparing papers or involved in conference organization. Brazil is hosting a major world conference on the environment in 1991. Conferences generate public support, identify problems, and recommend courses of action. However, too many conferences can be counterproductive. It is fairly obvious that everyone is aware of the problems of the Amazon region and many plans have been formulated. The people preparing for and attending conferences are not activating these plans. The time and money spent on conferences might better be spent on research, training, and putting these plans into action.

Objectives of Land Management in the Amazon Region

The objectives of land management in the Amazon region are, in principle, the same as for any other area.

1. To manage the land, forest, and water resources to sustain the maximum continuous benefit for the local residents and all of the people of Brazil.
2. To provide food and other resources for the increasing population.
3. To protect and preserve all species of plants and animals.
4. To provide surplus revenue from harvested products in the form of taxes, fees, and profits to contribute to the general economy of Brazil.

At present, these objectives are not being met. Food must be imported, the local people are generally poor, some species of plants and animals are endangered, and the Amazon region does not contribute positively to the Brazilian economy.

Recommendations

Some of the steps that can be taken to reduce the deterioration of the Amazon forests and develop sustainable agriculture and forestry are:

1. Complete the initial overall biogeoclimatic zoning. This zoning will form the basis for all future land use planning and will enable the government to direct farmers, forest companies, and other users to the land best suited to their need.
2. Develop land-use planning criteria and soil and forest inventory standards. Uniform criteria and standards are necessary for land-use planning and to justify land-use decisions or allocations. They are essential for field administration.
3. Train soil, agriculture, and forest technicians. Field technicians are essential to control and improve land-use practices. Government legislation without follow-up by field personnel will be ineffective.
4. In areas near highways and population centres, intensify the land-use and zoning surveys. These are the areas where the farmers and forest users will migrate first. Because the Amazon region is not homogeneous, detailed surveys are necessary before people start to develop and area.
5. Increase the extension service to assist farmers and forest operators. Immigrants with a low education level require guidance, particularly when they are becoming established.
6. Continue the agricultural and agro-forestry research to develop more economical sustainable crops. The Amazon region has undeveloped potential. Wherever possible, research should be accompanied by demonstration farms and forests so that people can see the procedures and results.
7. Conduct multidisciplinary environmental studies to determine the effects of logging on the soil and forest and to recommend harvesting systems and silvicultural prescriptions for different biogeoclimatic zones. These studies, like demonstration areas, show the results of different practices.
   The results of multidisciplinary studies would be more acceptable if they were conducted by a team of experts from different countries, coordinated by FAO. FERIC has forest-engineering expertise and has participated in large Canadian multidisciplinary projects. FERIC is qualified to participate in these studies, to design road networks, and to propose harvesting systems.
8. Establish lumber and plywood standards and train mill workers and inspectors. It will be impossible to develop and sustain economic export markets unless the customers are assured uniform standards.
9. Monitor the Jari project to determine the future role of plantation forestry and pulpmills in the Amazon region. This monitoring might also be more acceptable if conducted by an international team. FERIC is qualified to conduct evaluations of the harvesting and transport systems.

Conclusions

The Amazon region is vast and mostly untouched. In spite of the government's efforts to date, the unnecessary destruction of the forest is increasing. The people of the Amazon region, Brazil, and the world need the agricultural land and resources of the Amazon. Sustainable economic agriculture and forestry are possible in many areas. Many of the reports published and broadcast by the Canadian media are exaggerated and pessimistic. The suggested boycotts of Brazilian products to protect the forest are misguided and if implemented will further increase the poverty of the local people.

The campaign being waged by environmental and special interest groups to preserve the Amazon region and stop development is similar to the campaign against further harvesting of Canadian old-growth forests.

FAO and the developed countries can assist Brazil to introduce improved methods and train its agricultural and forestry people. Canada has much to offer Brazil because of its knowledge of agriculture and forestry and ongoing experience in land-use planning and development. The Amazon region has a vast reservoir of commercial wood and fibre. Opportunities may exist for joint ventures with Canadian forest companies in sawmills, plywood, and pulp and paper.

FERIC, with specialized expertise in the development of natural forests and experience as a participant in multidisciplinary projects, could assist Brazil to develop forest-road networks and harvesting systems for sustainable commercial forestry.