Briefing Paper
Plantations Campaign

PULPWOOD PLANTATIONS:
A growing problem
World Rainforest Movement

Pulpwood plantations: a growing problem

To millions of people across the world today, the pulp and paper industry is a growing problem. The chipping of native forests to provide raw material for the industry is being opposed bitterly by local people and environmentalists from Australia to Finland, and from Chile to Canada. No less widespread are protests at pollution from giant pulp mills which has sucked oxygen from rivers, ruined fisheries and drinking water supplies, and increased the burden of highly-toxic chlorinated organic compounds in animal and human bodies.

This briefing paper is concerned with a third activity of the pulp and paper industry --one which is often less well-publicized and which, at first glance, might seem more benign: planting trees. To help feed pulp and paper mills, vast monocultures of conifers, eucalyptus, acacia, and other species are being established both in the North and, increasingly, in the South, where fast tree growth, inexpensive land and labour, and lavish subsidies combine to make wood especially cheap. As swatches of exotic trees invade native woodlands, grasslands, farmlands and pastures, the results, in country after country, have been impoverishment, environmental degradation, and rural strife.

Commercial plantations are not forests

Plantations, like forests, are full of trees. But the two are usually radically different. A forest is a complex, self-regenerating system, encompassing soil, water, microclimate, energy, and a wide variety of plants and animals in mutual relation. A commercial plantation, on the other hand, is a cultivated area whose species and structure have been simplified dramatically to produce only a few goods, whether lumber, fuel, resin, oil, or fruit. A plantation's trees, unlike those of a forest, tend to be of a small range of species and ages, and to require extensive and continuing human intervention.

The distinction, of course, is not always hard and fast. A "native forest" where economically unimportant species have been eliminated may wind up as simplified, and as in need of constant human maintenance to stay that way, as any plantation. Much of Europe's "forest" falls into this category. On the other hand, some diverse, seemingly "natural" forests either began their existence as plantations, having then been abandoned, or continue to be carefully "cultivated" by local people, as is the case in areas inhabited by the Kayapo in Brazil.

The industrial monocrops with which this briefing paper is concerned, however, have a much less ambiguous status. Resulting from an aggressive and thoroughgoing transformation of a landscape, they are much closer to an industrial agricultural crop than to either a forest as usually understood or a traditional agricultural field. Usually consisting of thousands or even millions of trees of the same species, bred for rapid growth, uniformity and high yield of raw material and planted in even-aged stands, they require intensive preparation of the soil, fertilisation, planting with regular

spacing, selection of seedlings, weeding using machines or herbicides, use of pesticides, thinning, mechanised harvesting, and in some cases pruning. Such plantations may be established either on large parcels of land owned or rented by a company or on a large collection of smallholdings.

Even many "non-industrial" plantations are today being established on this industrial model. In some places, for instance, large-scale rapid-growth monocrops are being grown on the false assumption that they can "protect" water catchment areas or soils in the way a native forest would. Other extensive monocrops, often of exotic species, are being established with the stated purpose of providing fuelwood to local people. Industrial-type plantations are also being promoted as a way of absorbing emissions of carbon dioxide which lead to global warming: companies or countries are held to have "compensated" for their heavy CO2 emissions in one place if they plant swatches of fast-growing trees in another.

In contrast to such plantations --which are organized to be highly responsive to one or two demands of large-scale manufacturing concerns or other powerful centralizing actors-- are attempts to plant trees in ways responsive to a wide variety of interlocked local concerns. In some agroforestry systems, for example, a diversity of trees are chosen and planted to provide protection, shade and food for livestock, fruit and wood for humans, and protection, nutrients and water for crops, thus helping to keep production diverse and in harmony with local landscapes and needs.

Another useful contrast to the industrial plantation model is offered by efforts to restore degraded forests or woodlands by planting trees of some or all of the original species. Here the objective is not to produce large quantities of whatever wood is suitable for industrial markets, but to restore diverse ecosystems using native species. Thus a eucalyptus tree, when planted in one of its native regions in
Australia as a way of helping to regenerate an earlier ecosystem in ways approved by local people, may be considered to be a contribution to reforestation. The same tree, when planted as part of a large-scale pulpwood monocrop in India or Uruguay, is not only not a contribution to "reforestation", but is likely to contribute to environmental degradation and social problems. Planting a tree, whether native or exotic, is in itself neither a positive or a negative process. It is the social and geographical structures within which that tree is planted which make it one or the other.

Emergence of large-scale plantations in the South

The rapid expansion of the wood fibre, pulp and paper industries, fueled mainly by the North's voracious demand for paper pulp, has been one important cause of the commercial exploitation of forest areas. The past few decades have seen the paper industry deplete many old-growth forests in North America's Pacific Northwest, Australia, the Nordic countries, Chile, Indonesia and elsewhere. As native forests are exhausted, environmentalist pressures have emerged, further cutting into pulpwood harvests.

Such developments are leading the pulp and wood industry not only to look toward as-yet unexploited old-growth forests, for example in Siberia, but also to plan for increasing reliance on plantation fibre. Plantations are especially attractive in that they promise to be able to furnish exceptionally uniform raw material more quickly than natural forests and on a smaller land base. While industrial plantations currently account for only about 15-30 per cent of world demand for pulpwood, this ratio is bound to rise, given deforestation, decreased availability of extensively-managed forests, the limitations of recycled fibre, and the resistance of much of the industry to non-wood raw materials.

The more the pulp and paper industry is forced to shift from natural forest to plantation pulpwood, the more incentive it has to shift raw fibre production to the South. For one thing, fast-growing trees

such as eucalyptus can on the whole grow much faster in the South than any commercial species do in the North, meaning both that they are available earlier and that less land is required for plantations.

While the average growth rate of managed forest and plantations in the US is about 2.6 cubic metres per hectare per year, pine plantations in the South have been shown to yield from 5.7 cubic metres at certain locations in Madagascar to 30 in some Chilean plantations. Southern eucalyptus plantations have meanwhile yielded an average of 15-30 cubic metres annually per hectare in many countries, all the way up to 60 under certain exceptional regimes in Brazil.

Land is also cheaper in the South, particularly in big contiguous parcels. In many countries, for example, the state rents out nominally "forested" reserves to plantation companies at well below market rates. In Indonesia, state land can be rented by plantation firms for about US$0.30 per hectare per year and in Thailand for around $2.50. In the US, by contrast, land rental dominates the costs of tree planting programmes. All this makes for low wood costs in the South compared to the North.

According to the Canadian consulting firm H.A. Simons, the cost in 1988 of producing one bone-dry metric ton of hardwood fibre was only a bit over US$28 in Brazil, Chile and Argentina, $40 in the southeastern US, $49 in the interior of British Columbia, $102 in the Nordic countries, and approximately $154 in Japan. Softwood fibre production costs, according to the same company, were less than $28 in Chile but over $42 in the southeastern US, over $70 in Australia, and over $140 in Japan.

Such differences in cost are critical, since wood represents 40 to 70 per cent of the variable cost of making pulp, which is in turn the most important cost in making paper. It is thus often profitable to grow wood in the South even if the plantations are at a great distance from large paper markets. Barring political and economic turmoil, the move to the South for raw fibre is likely only to accelerate in coming years, as wood chips from the northwestern and southeastern US and western Canada become scarcer or more expensive.

Discounted land is not the only subsidy encouraging the expansion of pulpwood plantations in the South. Other subsidies which governments help make available include direct economic incentives, tax exemptions, low-interest-rate loans, low-cost labour and political repression. Hourly wages in Brazil, for example, are 20 per cent of those in Germany. Suppression of labour unions is meanwhile provided free of charge by the governments of many countries witnessing a plantation boom. Such subsidies, moreover, are topped up through support by international agencies and even NGOs for infrastructure and research and development programmes which disproportionately benefit the industry.

The move to plantations, and in particular plantations in the South, coincides with the growing acceptability to manufacturers of plantation fibre, especially eucalyptus. Conversely, the greater the inroads plantation fibre gains into the industry, the more manufacturers will be encouraged to treat wood fibre as a factor whose composition and characteristics can be radically rearranged and simplified at will. Whereas the industry has previously been largely dependent on diverse types of wood waste, and thus has had to rely largely on manufacturing processes to ensure uniform quality in paper, it is now increasingly capable of reducing variability in the raw material itself.

The result has been the establishement of huge pulpwood plantations in Indonesia, Brazil, South Africa and Chile, and an ever increasing plantation area in numerous other countries such as Malaysia, Vietnam, Thailand, Uruguay, Paraguay, Argentina, Venezuela, Colombia, Mexico, Congo, and Swaziland, while scores of other countries are already joining the plantations boom.

Shifting pulp production

Some of the same incentives which encourage the industry to shift pulpwood production to the South also encourage it to build pulp and paper mills there. Cheap land in big contiguous swathes, for instance, is an advantage not only for plantation interests but also for pulp manufacturers, since state-of-the-art pulp mills tend to be huge and are thus most economically sited in the centre of large, compact raw-material catchment areas. Low labour costs are of course also attractive to pulp firms, as is the eagerness of many Southern governments to offer attractive economic incentives or "apply stimuli" to the industry. Looser environmental regulations provide still another attraction. In 1990, the pulp and paper industry in North America had to devote 54 per cent of its total spending on new plant to environmental measures, and in Western Europe, 26 per cent, while elsewhere the figure was only 10 per cent.

Small wonder, then, that Southern-produced pulp can be as cheap, relative to that of the North, as Southern-produced wood. In 1993, for example, bleached hardwood pulp cost only US$78 a tonne in Brazil but $156 in Eastern Canada and $199 in Sweden. New regional and global trade agreements such as GATT/WTO are making it easier for the industry to take advantage of such cost differentials by shifting production to the South.

Pulp, moreover, has more value added, and, when dried, is more efficient to ship than logs or wood chips, which are up to half water. One dry tonne of hardwood pulp is roughly equivalent to 2.5 tonnes of hardwood chips; while it costs US$150 to ship, from Chile to Japan, enough softwood to make a tonne of dry pulp, it costs only $55 to ship the pulp made from that softwood. This is one reason plantation sites and mills have been integrated in the export sectors of Brazil, Indonesia, and other Southern countries.

While the cost of capital for mills tends to be higher in the South than the North, Southern countries can offer compensations which are often more than adequate, including soft loans from multilateral development banks. In order to be able to reschedule the debt service on such loans, Southern producers are often forced to reduce prices to keep orders and foreign exchange coming in. That pushes paper prices down worldwide. Hard-pressed to compete and hold market share, some Northern firms may be driven to subcontract out some of their basic production to their Southern counterparts.

Contributing to pressures to establish mills in the South is Northern firms' need to export pulp and paper machinery. In the early 1990s, for example, a severe economic recession engulfed Finland, a country particularly vulnerable to pulp and paper industry cycles due to the high 30 per cent share its forest industries contribute to GNP. What with heavy indebtedness, cost-cutting and layoffs by the forest industry, firms such as Tampella, Valmet, Sunds Defibrator, and Ahlstrom began to strive especially hard to find more Southern outlets. Helped by Finland's Premixed Concessional Credit Scheme and the Finnish "foreign aid" budget, Finnish machinery exports to Indonesia surged from nil to over US$100 million between 1990 and 1993, while those to Thailand increased nearly fivefold, to almost $110 million, over the same period.

Nordic-country consultancies in forestry, engineering and pulp and paper manufacture are also eager to find more contracts abroad. Some 10 per cent of Finland's professional foresters were reportedly unemployed in 1994, and many are eagerly seeking corporate or "foreign-aid"-funded jobs in the South. With their ability, through inside connections, to appropriate "aid" funds for what are essentially commercial purposes, Nordic forest industry consultants are also invading Laos, Cambodia and Vietnam in large numbers, swamping local bureaucracies with money and plans, in their attempt to repeat past industry "successes" in Brazil and other countries.

Impacts of Industrial Plantations

Most large-scale commercial forestry plantations in the South are promoted and established in inhabited locations by government agencies, national and foreign businesses, multilateral banks, or other organizations external to the area. Although their aim is not to improve local quality of life, but to obtain large amounts of wood in the shortest possible time, both businesses and governments usually try to publicise locally the advantages that plantations supposedly will bring to local people. On a national level, too, it is often claimed that much of the economic and social future of a country depends on plantations and pulp, which are said to generate both direct and indirect employment, increase exports and support the country's development. Experience demonstrates, however, that the environmental problems of large-scale industrial plantations tend to be social and economic as well, and on both local and national levels.

In recent years, eucalyptus, because it is planted so extensively, has become a symbol of large-scale tree crops in the South. However, it would be wrong for analyses of the impacts of such plantations to centre on the botanical or ecological characteristics of eucalyptus. The problem lies not in any particular species and its unique biological features, but in how it is used. The issue is not substantially different when any other tree --native or exotic-- is planted on a large scale to supply industry and impacts from large-scale plantations of pines, gmelina, acacia and other species have proven to be very similar to those recorded for eucalyptus.

Local impacts

Plantations normally replace crops, grasslands, or old-growth, secondary, or scrub forests. Due to commercial necessities, they are rarely established on degraded soil, as their objective is short cycles of rapid growth requiring a certain level of fertility and water supply. Hence they typically occupy areas already being used in various ways by local people.

In some areas, the population is sparse and land tenure is both clearly defined legally and little-contested. In other areas, where the population is dense and many landholdings are undocumented, local people's farms may be threatened when the state cedes land to forestry companies. In still others, plantations may usurp lands traditionally used by the community as a whole. These lands can include both communal fields and pastures, whose disappearance can force local people into overexploiting adjacent lands or forests.

Large-scale, fast-growing tree plantations threaten local agriculture in less direct ways, too. They may, for instance, usurp water needed by other crops or by livestock. Species whose numbers had previously remained small, meanwhile, can rapidly become economic pests when large monocultural plantations are introduced. Such pests, which range from mammals, birds and insects to fungi and viruses, can affect both the plantations themselves and neighbouring agricultural crops and even livestock.

Finally, the roots of plantation trees, especially eucalyptus, because they extend several metres horizontally, can also threaten neighbouring crops by competing for their water and nutrients. In Northeastern Thailand, villagers say that Eucalyptus camaldulensis is selfish in its nutrient use. Fast-growing trees, of course, can also cut off sunlight to crops planted in or near plantations. All these impacts are especially serious in densely-populated rural areas, where a reduction in production, however small, may have catastrophic effects, both threatening subsistence and raising food prices.

Plantations' takeover of forests can also lead to severe social, economic and cultural problems. Forests often supply water and compost for crops, fodder for livestock, and vegetables, game, honey, fruit, mushrooms, fibre, firewood, building wood, and medicine for local communities, and in addition are frequently a source of spiritual values. Where they disappear, diets, health, housing and incomes alike may suffer.

Of course, plantations often also create conflicts within local societies between those who oppose and those who assimilate to them, or, to use the rhetoric of many central authorities, between "backwardness" and "progress". The construction of associated pulp mills, in addition, can burden local communities with thousands of migrants seeking work. The enormous economic power wielded by large pulp and plantation firms meanwhile tends to distort local politics. As whole regions become almost totally dependent on the industry, local and regional governments are forced more and more to bend their policies to suit its needs.

In some social contexts, large-scale industrial plantations can create local employment, and this is one of the main arguments wielded everywhere both by state and corporations to convince local communities to accept the projects. However, very often plantation development results in a long-term net loss of employment. Although figures vary widely from place to place and source to source, on the whole there appears to be agreement that industrial plantations cannot employ as many people as conventional agriculture, particularly family agriculture. The jobs created, moreover, are mainly for seasonal casual labourers, in particular during the plantation phase. Few climates allow planting to be carried out year round. On the whole, working conditions vary from bad to terrible.

National-level impacts

The local social impacts of tree plantations, when taken in sum, can give rise to national-level problems. For instance, the displacement of thousands of people by big plantation schemes imposed or voluntary, direct or indirect can swell shanty towns in the big cities of the South, giving rise to increases in poverty, crime and prostitution and leading to land disputes with other communities.

The agroexport development model on which large-scale tree plantations in the South are usually based can also create economic problems on a national scale. One problem is concentration of wealth. Occupying large areas of fertile land, industrial plantations require state support and heavy, long-term investments varying from 600 to several thousand US dollars per hectare. In the vast majority of cases, they need direct subsidies, tax exemptions, soft loans from foreign creditors, forestry research, road construction, improved port installations, and other subsidies which are extracted from a nation's people as a whole. In some cases a country's people also has to underwrite the construction of stupendously expensive modern pulp plants. Yet while these costs have to be met by all citizens, very few reap the profits.

Concentration of wealth implies concentration of power and dispossession of local communities. In Thailand, industrial plantations have been an exceptionally efficient device allowing interests responsive to the world economy to annex supposedly marginal areas, smash the remaining local-oriented noneconomic or semi-economic pattern of livelihood and nature conservation there, and convert the fragments into resources for global exchange. As land is concentrated and transformed into a substrate for eucalyptus, local villagers are cut loose to seek niches as producers, consumers, recyclers or (in the case of prostitutes) commodities in the world economy.

A further problem is the risk of national dependence on a commodity prone to wild tumbles in price. Between mid-1993 and late-1995, a tonne of benchmark pulp increased in price from US$390 to nearly $1000, yet by mid-1996 had dropped again to under $500.

Indiscriminate planting of pulpwood trees or any other crop, moreover, can lead to a glut of raw materials which, however beneficial it may be for paper manufacturers and users, makes their cultivation progressively less profitable. Indeed, tree crops on the whole are already chronically unprofitable in strict market terms, as otherwise they would not need so many state subsidies. But new risks are being added by the planting of millions more hectares of tree crops around the world in the next few years, which may put pulpwood into the bracket of other Southern primary commodities such as rubber and coffee, whose prices have fallen to persistently uneconomic levels.

Yet Southern countries which have committed themselves to pulpwood exports, as to other commodity exports, are likely to have to continue exporting at ever-lower prices, competing among themselves for industrialized-country buyers. Indeed, the situation is even more serious for pulpwood than for annual crops, since it is not only much more expensive to cut trees prematurely than to plough a crop which has not yet matured, but also more difficult to return land to agriculture after trees -particularly eucalyptus- have been intensively cultivated on it. In addition, the tree plantations in question may have been occupying the land for a number of years, raising financial losses even higher.

Impacts on water

Tree crops have been publicised as performing functions similar to those of a forest in the maintenance of the water cycle. Some plantation proponents have even gone as far as to state that the tree plantations in prairie ecosystems help to regulate the water cycle. Such affirmations are groundless.

In ecosystems which have not been radically modified recently, the naturally-occurring vegetation possesses characteristics which ensure long-term balance in the water cycle. The morphology and physiology of the component species of the local ecosystems tend to be adapted to make most efficient use of available rainfall. Large-scale tree plantations, however, modify all of the following:

The ratio between the amount of water intercepted by the foliage and the amount of water reaching the ground. The foliage of a plantation differs from that of a natural forest, a savanna or a prairie, in biomass, height, form of cover, and shape and distribution of leaves and branches. Plantations also generally lack undergrowth. These characteristics change the quantity of water intercepted and evaporated. Thus, the soil will tend to receive either more or less water than that received under the original vegetation.

The ratio between the amount of water which runs off the surface and the amount of water which is absorbed by the soil. This is affected by factors such as the type of humus generated by the plantation and the quantity of accumulated leaf litter, which facilitate or complicate the absorption and infiltration of water which reaches the surface. The volume of water which crosses the canopy also affects this ratio. Soil compaction after the use of heavy machinery, in addition, impedes infiltration, and encourages evaporation.

The ratio between the amount of water evapotranspired and the amount of water which enters the subsoil water supply. This ratio depends largely on how much water is used by the species planted. There is a direct relation between trees' rate of growth and their water consumption. In plantations that use the fastest-growing species, water consumption tends to be extremely high.

To begin with, then, we can be almost certain that a plantation will introduce changes in the water cycle. The type and degree of changes will not only depend on the species planted and its

management, but will also be affected by the local climate (volume of rainfall, seasonal changes, droughts, temperature, winds), topography and soil type.

Water deficits caused by plantations can result in a number of impacts such as:

Reduced availability of water for other agricultural production and industrial activities.

Problems of water supply for hydroelectric generation systems.

Discontinuity in the flow of watercourses in low periods.

Less water for local communities and urban centres. As a general rule, where trees replace non-forested land uses, the overwhelming evidence from catchment research is that following reforestation, groundwater levels are lowered and stream yields are reduced, both effects being more pronounced during the dry season or growing season.

The modification or destruction of other natural ecosystems, such as wetlands..

Faced with a lack of agreement between their theoretical models of plantation water use and some of their empirical observations, some foresters have chosen to disregard the empirical observations.

In Chile, for example, plantations of Pinus radiata have in some cases caused springs and other natural sources of water to dry up, while at the same time rendering the flows in rivers irregular, with valleys being inundated during the rainy season. Faced with such observations, one soil professor and forestry expert stated that "the pine was brought in as a high yield product and it needs sufficient water to produce wood. Nonetheless, I would doubt that a pine forest consumes a quantity of water much higher than a natural forest does." He then contradicted himself by affirming that in terms of consumption, as the pine is a rapid growth species and has a greater biomass, it would be expected to have water consumption several times higher than the native forest.

Less confused were the simply-expressed observations of a Chilean farmer. Having inherited an area of eight hectares, nearly totally planted with pines, the farmer found that he could get no water even for household use. As the plantation matured it was sold, with all the pines being cut and only a small copse of oak in a ravine being conserved. To his surprise and that of his neighbours, a dried-up stream then reappeared. Precisely parallel observations of the recovery of streams, wells, and standing bodies of shallow water crucial for water buffalo and other livestock have been made by Northeastern Thai farmers following the harvest of eucalyptus plantations.

In Northeast Thailand, in fact, eucalyptus often lowers ground water so much that villagers cannot irrigate rice fields. This environmental damage is greatly resented by many farmers, and is one of their main reasons for complaining against the eucalyptus reforestation policy.

Even the United Nations' Food and Agriculture Organization (FAO), which has been and still is one of the main promoters of monoculture tree crops, is beginning to accept that the plantation of extensive areas of eucalyptus in any deforested water catchment area substantially reduces available water and that felling the trees will increase it.

Monoculture tree crops have had negative effects on the water cycle in widely differing areas. Although this conclusion does not imply that such negative effects will occur in and around all plantations, it is sufficient to justify obligatory environmental impact assessments wherever such plantations are planned. The problem, it can also be concluded, is not with any particular tree

species, but with high-yield industrial production, which tends to consume quantities of water in direct proportion to rapid growth. Added to this is the issue of the large scale of industrial plantations, which makes the problem more severe at the basin level, with serious repercussions on the economy, society and the environment.

Impacts on plants

Industrial plantations begin with preparation of the soil. Most local plant species are removed. Pioneer species which return are destroyed either by mechanical clearing or by herbicides. Once the plantation trees reach a certain age, they impede the development of most other plant species as a result of increased shade, accumulation of leaf litter and dead branches on the ground, competition for water and nutrients, the cumulative effects of certain changes in the soil, and with some species, chemical substances that negatively affect the growth of other species.

The few non-commercial species which do manage to survive in plantations or in fire-breaks are periodically eliminated to reduce the risk of fire. The ecological characteristics of the plantation species themselves, together with the intensive management and felling carried out when the trees reach the appropriate size for processing, entail that various flora which might otherwise be associated with such trees (epiphytes, parasites, climbing plants, and so on) cannot develop. The impact of this reduction of plant biodiversity on local livelihood can be severe. In a single community in Yasothorn province in Northeast Thailand, for example, eucalyptus' destruction of local grass cover deprived local cattle and water-buffalo of grazing, forcing a dozen families to abandon their homes.

Photographs are sometimes shown of plantations with extensive undergrowth. Such cases, however, are typically not industrial monocultures, but abandoned or unmanaged plantations in which local pioneers have begun to move in, occupying, in particular, spaces which open up between trees in old plantations.

It is sometimes claimed, too, that in some cases plantations increase local plant growth, as for example when they replace non-forest communities. Two FAO consultants, for instance, claim that plantations "create a forest environment which normally produces a beneficial result." They admit, however, that it is "improbable" that plantations encourage the species characteristic of the previous unpopulated terrain, and another FAO study concedes that when indigenous plant communities (forest, woodland or grassland) are converted to monospecific or polyspecific plantations of native or exotic species, with the main purpose of wood production, generally "there will be a reduction in both habitat and species diversity at that site."

Impacts on animals

For most local animals, a plantation is a desert, lacking food, shelter and opportunities for reproduction. The species commonly used in plantations are exotic, and their principal advantage stems from the near absence of "pests and diseases" in the new environment at the time they are planted. Yet however positive this may be for the forest investor, it is not so for the local fauna whose habitat is replaced.

For some species, plantations provide shelter from predators, but this can lead to a drastic reduction in the predator population and uncontrolled increases in the prey population. In many regions of Chile, for example, plantations have caused a drastic reduction in fox numbers and a related increase in numbers of rodents and rabbits, which in turn affect the pines in the plantations.

Imbalances generated by plantations affect a very wide group of species, the majority of which are unobserved by non-residents and non-specialists. The enormous variety of life forms existing within the soil (including bacteria, viruses, fungi, small insects, and worms) can suffer large impacts from the combination of changes in leaf litter and other decomposing vegetable matter and changes in the chemical composition and structure of the soil. The use of agrochemicals also importantly alters soil flora and fauna.

Industrial plantations are characterised by intensive management, based fundamentally on calculations of economic yields. Trees never reach full maturity, but are felled when they attain optimum sales dimensions or their growth slows. Plantations thus harbour few of the mature, diseased or dead trees which serve as microhabitats for fungi and insects, which in turn serve as food for other animals. Epiphytes and climbing plants which support other fauna also tend to disappear.

A small group of species manages to adapt to newly-created plantation environments. Even some of these species, however, are exterminated because they impede plantation development. In Uruguay, Argentina and Brazil, for example, leaf-cutting ants --one of the few insects which can feed on pine and eucalyptus plantations-- need to be poisoned to ensure the plantations' survival. The contamination which results, of course, affect other animals which are inoffensive to the plantation trees. The few species which manage to adapt themselves to plantation ecosystems, moreover, suffer the destruction of their new habitat every few years when harvest time comes round. In the case of eucalyptus this happens every six to ten years, and with pine, every 12 to 20.

The impact of a plantation on animals, like that on plants, goes beyond its boundary, as species benefiting from the plantation increase in number and those harmed by it decrease. Fires beginning in plantations spread into surrounding ecosystems, while agrochemicals affect aquatic flora and fauna within and outside plantations when waterways become polluted with minerals or chemicals.

The homogeneity of extensive tree plantations constitutes a serious problem for the plantations themselves. The great initial advantage of exotic trees --the absence of local fauna accustomed to using them as food-- can become an Achilles heel in the long term, when predators adapted to this species do begin to appear. At that point the food desert becomes a feast for one species, which can expand exponentially and seriously damage or annihilate whole plantations. Such was the case in Uruguay with Pinus radiata, which had to be abandoned due to serious attacks by the pine shoot moth Ryacionia buoliana. A similar fate befell Gmelina arborea in Brazil, and monoculture tree plantations established by the Paper Industry Corporation of the Philippines have been plagued by pests for the same reason.

Impacts on soils

Many existing studies of the impacts of industrial tree plantations on soils confuse the issue by citing irrelevant research. For example, a recent FAO publication notes that the "effects of uncropped eucalypts on soil quality have been compared with [those off] other species and . . .treeless areas." The studies were mostly in India and the Mediterranean and are fairly recent. Eucalyptus were found to "have a beneficial effect on soil structure and compared favourably with pine and Shorea robusta (Sal, a local tree). On treeless sites eucalyptus improved soil fertility through decayed leaves and litter."

This quotation is used to suggest that in general, eucalyptus improve soil quality. Yet the example refers to unharvested plantations, while large monospecific plantations of any species are normally planted to be harvested and not to improve the soils. Moreover, in the real world in which investors are bent on obtaining high yields, large-scale plantations tend not to be established on degraded

soils of the kind the FAO appears to describe, where trees grow poorly. When discussing the effect of real-world commercial plantations, it is more relevant to examine a later passage in the same work, which says that, in managed and harvested plantations, the "nutrient capital changes considerably because nutrients are removed from the site."

Once such confusions are cleared up and the discussion is concentrated on industrial monocultures, plantation proponents are forced into a final argument, which relies on a comparison between industrial tree crops and the agricultural crops of the Green Revolution model. Industrial plantations, the argument goes, should not be the subject of special environmentalist concern since they are much less degrading to the soil than such crops. For example, the FAO cites a study showing that "the amount of nitrogen taken in by the cereal crop is two and a half times more that the amount taken by the eucalypt plantation, and 15 times more in the case of phosphorus."

Green Revolution-style silviculture, in other words, can defend itself only by saying that it is not quite as bad as the movement from which it draws much of its inspiration. This defence, in addition to being ineffective against critics of the Green Revolution in agriculture, implicitly abandons the premise that one of the main points of tree cultivation is to foster non-agricultural, forest-like environments. This nutrient depletion occurs with both eucalyptus and pine, as is admitted even by active promoters of industrial plantations such as FAO and Shell:

FAO: "The short-rotation harvesting of eucalyptus, especially when the whole is used, leads to the rapid exhaustion of the reserves of nutritive elements in the soil. The above is a direct consequence of their rapid growth. Certain evidence exists to show a greater removal of nutrients in pine plantations under similar conditions."

Shell: "... whole-tree harvesting and short-rotation forestry does remove much of this pool of nutrients, not only reducing soil fertility,.., but also acidifying the soil."

Short-rotation plantations, in addition, require more frequent management interventions, which make the soil more prone to erosion and other forms of nutrient loss. Heavy machinery compacts the soil, making it difficult for water to infiltrate, also promoting erosion. Log extraction, meanwhile, breaks the soil's surface, leaving it exposed to the erosive action of rain. The tendency towards increased mechanisation, and the replacement of chainsaws by large harvesting machines, is likely only to intensify damage to soils. It is therefore absurd to suggest without qualification that any sort of tree planting protects or improves soil quality. All evidence shows that, on the contrary, industrial plantations degrade soils, and that their functions can in no way be compared with those of natural forests.

Conclusion

Large-scale industrial tree plantations undoubtedly help the international pulp and paper industry secure stable supplies of raw materials. They, together with the subsidies they attract, are also capable of periodically making sizeable profits for the huge conglomerates which plant them. They are not designed, however, to benefit Southern countries as a whole, their people or their environments. Although they normally destroy more employment than they create, they nevertheless rely on subsidies extracted from large numbers of people to generate their profits. They do not help preserve land, forests, grasslands, or water sources, but rather exploit local natural advantages ruthlessly.

Neither Southern countries nor their local communities, therefore, should hope to benefit from the presence of huge plantation and pulp firms producing for export. On the contrary, they must be on

their guard against the damage these corporations can wreak. While plantation tree roots may be with in national territory, it is very unlikely that the roots of such companies will be.

Note: this briefing is based on a summary of "Pulping the South: Industrial Tree Plantations and the World Paper Economy" (Carrere, R. & Lohmann, L., London, Zed Books, 1996), published in Watershed 2 (1) July-October 1996, Thailand, TERRA