

SILVA FENNICA

1985 Vol. 19 N:o 4

| | | |
|-----------------------------|--|-----|
| Sisällys <i>Contents</i> | MARKKU SIMULA: Forestry and development – a global viewpoint | 339 |
| | <i>Seloste: Metsätalous ja kehitys – globaalinen näkökulma</i> | 354 |
| | JARI PARVIAINEN: Istuttamalla perustetun nuoren männikön, kuusikon, siperianlehkikuusikon ja rauduskoivikon kasvu | 355 |
| | <i>Summary: Growth of young Scots pine, Norway spruce, Siberian larch and silver birch plantations</i> | 363 |
| | P. A. HAROU: Comparison of methodologies to evaluate aid programs to nonindustrial private forests | 365 |
| | <i>Seloste: Yksityismetsiin kohdistuvien avustusohjelmien evaluointimenetelmien vertailu</i> | 374 |
| | MARKKU HALINEN: Männyn nuoruusvaiheen kasvunopeuden vaikutus sahatavaran laatuun | 377 |
| | <i>Summary: The effect of the growth rate of young pine on the quality of sawn goods</i> | 385 |
| | KARI LÖYTTYNIEMI: On repeated browsing of Scots pine saplings by moose (<i>Alces alces</i>) | 387 |
| | <i>Seloste: Männyntaimien toistuvasta hirtvivoituksesta</i> | 391 |
| | CARL JOHAN WESTMAN, TAPIO NUMMI & MATTI LEIKOLA: Käytännön typpilannoituksen vaikutus varttuneiden kuusikoiden kasvuun ja tuotokseen | 393 |
| | <i>Summary: The effect of large scale nitrogen fertilization on growth and yield of mature Norway spruce stands in south-western Finland</i> | 404 |
| | KRISTINA PALMGREN, ANNA SAARSALMI & ASSI WEBER: Nitrogen fixation and biomass production in some alder clones | 407 |
| | <i>Seloste: Eräiden leppäkloonien typpensidonta ja biomassan tuotos</i> | 419 |
| | MATTI KÄRKKÄINEN, JUKKA PIETILÄ & RAILI VIHOLA: Suomalaisen puulajien iskutaivutuslujuus tuoreena | 421 |
| | <i>Summary: Impact bending strength of Finnish tree species in green condition</i> | 427 |
| | Käsikirjoitusten tarkastus vuonna 1985 | 429 |
| | <i>Appraisal of manuscripts in 1985</i> | 429 |

SUOMEN METSÄTIETEELLINEN SEURA
SOCIETY OF FORESTRY IN FINLAND

Silva Fennica

A QUARTERLY JOURNAL FOR FOREST SCIENCE

PUBLISHER: THE SOCIETY OF FORESTRY IN FINLAND

OFFICE: Unioninkatu 40 B, SF-00170 HELSINKI 17, Finland

EDITOR: SEppo OJA

EDITORIAL BOARD:

KAUKO HAHTOLA (Chairman), RIHKO HAARLAA, TIINA HEINONEN, JOUKO HÄMÄLÄINEN, VEIKKO KOSKI, SIMO POSO and MARKKU KANNINEN (Secretary)

Silva Fennica is published quarterly. It is sequel to the Series, vols. 1 (1926) – 120 (1966). Its annual subscription price is 180 Finnish marks. The Society of Forestry in Finland also publishes *Acta Forestalia Fennica*. This series appears at irregular intervals since the year 1913 (vol. 1).

Orders for back issues of the Society, and exchange inquiries can be addressed to the office. The subscriptions should be addressed to: Academic Bookstore, P.O. Box 128, SF-00101 Helsinki 10, Finland.

Silva Fennica

NELJÄNNEsvuosittain ilmestyvä metsätieteellinen aikakauskirja

JULKAISIJA: SUOMEN METSÄTIETEELLINEN SEURA

TOIMISTO: Unioninkatu 40 B, 00170 Helsinki 17

VASTAAVA TOIMITTAJA:

SEppo OJA

TOIMITUSKUNTA:

KAUKO HAHTOLA (Puheenjohtaja), RIHKO HAARLAA, TIINA HEINONEN, JOUKO HÄMÄLÄINEN, VEIKKO KOSKI, SIMO POSO ja MARKKU KANNINEN (Sihteeri)

Silva Fennica, joka vuosina 1926–66 ilmestyi sarjajulkaisuna (niteet 1–120), on vuoden 1967 alusta lähtien neljännesvuosittain ilmestyvä aikakauskirja. Suomen Metsätieteellinen Seura julkaisee myös *Acta Forestalia Fennica*-sarjaa vuodesta 1913 (nide 1) lähtien.

Tilauksia ja julkaisuja koskevat tiedustelut osoitetaan seuran toimistolle. *Silva Fennica*n tilaushinta on 120 mk kotimaassa, ulkomaille 180 mk.

FORESTRY AND DEVELOPMENT – A GLOBAL VIEWPOINT

MARKKU SIMULA

Seloste

METSÄTALOUS JA KEHITYS – GLOBAALINEN NÄKÖKULMA

Saapunut toimitukselle 28. 5. 1985

The area of world forests is gradually declining because of various human activities, such as shifting cultivation, uncontrolled logging and industrial pollution. Continuation of the current trends would have detrimental ecological, economic and social effects on the global scale. The diversity of the problem is wide. The situation in the tropical developing countries differs from that in the industrialized world. With the present rates of population growth and unchanged forest policies, the fuelwood shortage in developing countries is rapidly aggravating. The need for more agricultural land tends to prejudice conscious efforts to increase wood production.

The industrialized countries are experiencing problems in introducing forest policy means to maintain sufficient timber supply. Rapidly increasing pollution problems cause a serious hazard to the existence of the whole forest ecosystem. Forestry has primarily been a national issue of relatively low priority in political decision making, which has resulted in insufficient action to remedy the situation at national and international levels.

The renewability of forest resources represents a strategic asset, the importance of which is bound to increase in the long-run when the non-renewable resources become more and more scarce. If the current trends cannot be changed, the potential for badly needed economic and social change in the world's poor rural areas will be lost.

1. WORLD FORESTS AS A NATURAL RESOURCE

Forestry's potential contribution to the wellbeing of the mankind is vast, and time is getting shorter and shorter for its recognition.

Forests are the richest of the terrestrial systems of living organisms. The forest ecosystems produce a huge volume of biomass (stemwood, branches, leaves, ground vegetation, etc.) which changes continuously. These changes can be regulated by man and in fact, during the last few thousand years human activities have had a major impact on the worlds' forest cover and its composition. This paper attempts to give a general overview of the main current issues in world forestry which should be addressed at

higher than national level. The emphasis is given to social and economic aspects which are discussed based on the available projections on key variables up to the year 2000.

The Extent and Distribution of Forests

The area of forest and woodland is estimated at 39 mill. km² accounting for just under one-third of the total world land area. This compares with over 45 mill. km² of agricultural land (35 per cent) and 44 mill.

km² of all other categories. There is on average in the world slightly less than one hectare of forest and woodland per capita. This figure is decreasing under the twin influences of rising population and, in many regions, declining areas of forests. It is projected that by the year 2000 there will be only half a hectare of forest per person in the world. (Peck 1984).

The world forests can be divided into coniferous, broadleaved (non-coniferous) and mixed forests. The coniferous group is predominant in the boreal zone and the higher elevations of the temperate zone but they also occur in tropical and subtropical areas. About three quarters of broadleaved forests can be found in equatorial zone. These forests vary from moist tropical forests and mangrove swamps on the coast to dry wooded savannah. Between the northern coniferous belt and the tropical zone are the temperate forests of mixed or predominantly broad-leaved species.

The global forest area is almost evenly shared by the industrialized and developing countries (Table 1). The ecological and economic characteristics of temperate and tropical forests are, however, so different that they have to be considered separately, and even within these groups the diversity is wide.

Versatile Outputs

The principal output of forests is wood. The world removals amount to about 3.2 bill. m³ per year which corresponds to about 0.8 m³/ha. This is far below the production potential as the average annual increment could be in the range of 7.1 to 9.3 bill. m³ (Steinlin 1979). With intensive forest management higher yields could be obtained. As an indication of the possibilities, Finland with its severe climatic conditions and relatively poor soil fertility annually harvests 2.3 m³/ha, or three times the world average.

The use of wood includes fuel (54 per cent of the total), sawnwood, wood-based panels and paper. These products serve needs for heat, shelter, communication and packaging. Forests also provide a multitude of other products and services, such as gum arabic, medicinal supplies, oils and resins, fruits,

Table 1. World Forest Area and Standing Volume of Wood. 1980.

| | Total forest and woodland mill. ha | Closed forests | | Standing volume | |
|---------------|---------------------------------------|----------------|-----|----------------------|-----|
| | | mill. ha | % | bill. m ³ | % |
| WORLD | 3 930 | 2 860 | 100 | 301 | 100 |
| Developed | 1 886 | 1 508 | 53 | 137 | 46 |
| North America | 630 | 510 | 18 | 44 | 15 |
| Europe | 156 | 138 | 5 | 14 | 5 |
| USSR | 920 | 785 | 27 | 75 | 25 |
| Other | 180 | 75 | 3 | 4 | 1 |
| Developing | 2 044 | 1 352 | 47 | 164 | 54 |
| Africa | 563 | 203 | 7 | 40 | 13 |
| Latin America | 875 | 695 | 24 | 82 | 27 |
| Asia/Pacific | 606 | 454 | 16 | 42 | 14 |

Source: FAO 1981a

nuts, honey, berries and mushrooms, fodder and forage, food, clothing, etc. The environmental functions of forests include the prevention of soil erosion, the regulation of the quantity and quality of runoff, flood prevention, reducing siltation of reservoirs, regulation of the global oxygen-carbon cycle, modification of local climates and the provision of recreational services. Forests offer a habitat for millions of plant and animal species and their diversity is an essential factor in maintaining the ecological health of the globe.

There is a wide gap in the per capita levels of resource stock and wood production between the rich and poor nations (Table 2). Behind this disequilibrium there is a totally different man-forest relation induced by the stage and level of economic and social development. In the developing countries, the most critical issues are deforestation and how forestry can contribute to the economic and social development of local communities. In the industrialized world, the main problems are related to how acid rain and other effects of air pollution will affect the future forest cover, and how the demand for wood can be satisfied. The future supply of coniferous wood is a particular concern as it largely depends on the utilization of the vast virgin forests in the USSR and North America where the cutting areas are often transformed

Table 2. Forest Area and Wood Production per Capita, 1980.

| | Developed countries | Developing countries |
|--------------------------------|---------------------|----------------------|
| Forest area (closed) ha | 1.33 | 0.41 |
| Wood production m ³ | 1.19 | 0.55 |

Source: Table 1, FAO 1983b

into low-value secondary growth forests. Another problem of more regional nature is that prospects of more intensive utilization of the forest yield are shadowed by tendency to reserve increasing areas for other than wood production.

Renewability

The forest is a versatile renewable natural resource with a relatively wide range of output combinations which can be adapted to the various needs of man while still maintaining a healthy ecosystem. Biomass is generated from carbon dioxide, water and minerals by solar energy, and this natural process usually involves only marginal external in-

puts even in managed productive forests. Scientifically applied increased management intensity usually means improvement in the ecosystem, particularly in poorly forested areas.

In the long run, renewability is likely to become an even more important aspect than at present, while the availability of non-renewable resources is increasingly limited and more and more costly. Several key minerals are likely to be exhausted during the next century (e.g. OECD 1979) which will emphasize the unique characteristics of forests and the possibilities to expand the range of economic and social needs they are satisfying (cf. Beardsley 1976). Unlike non-renewable resources, forests grow and they can, in principle, perpetuate themselves indefinitely. On the other hand, if mature trees are not used, the growth potential is first lost and finally an elemental loss occurs due to mortality.

The economic growth of the industrialized countries would not have been possible without low-cost hydrocarbons which also enabled the extensive and capital-intensive utilization of the world's mineral resources. During the coming age of shortages, the forest industries' low intensity of external energy (with process residues as an internal energy source) will contribute to the value of forests as one of the world's most important natural resources.

2. FORESTRY AS A DEVELOPMENT AGENT

The relationship between forestry and economic development is close and dynamic with the following main characteristics related to the switch from the traditional rural societies through take-off and growth periods to post-industrial maturity and further to emerging ecologically oriented communication societies (definition by Peccei (1982)) (Figure 1):

- the reduction of forest area is generally associated with low levels of economic development or rapid growth;
- the intensity of forest resources utilization increases with economic development but starts declining in

mature societies for social and ecological reasons; and - the primary uses of forest products are first wood for fuel and construction; industrial roundwood dominates later becoming increasingly affected by recreation and environmental protection and conservation.

Economic Growth and Social Change

By its very nature forestry has been viewed as a potentially very important agent of economic growth which is badly needed in the world's poverty areas (e.g. Westoby

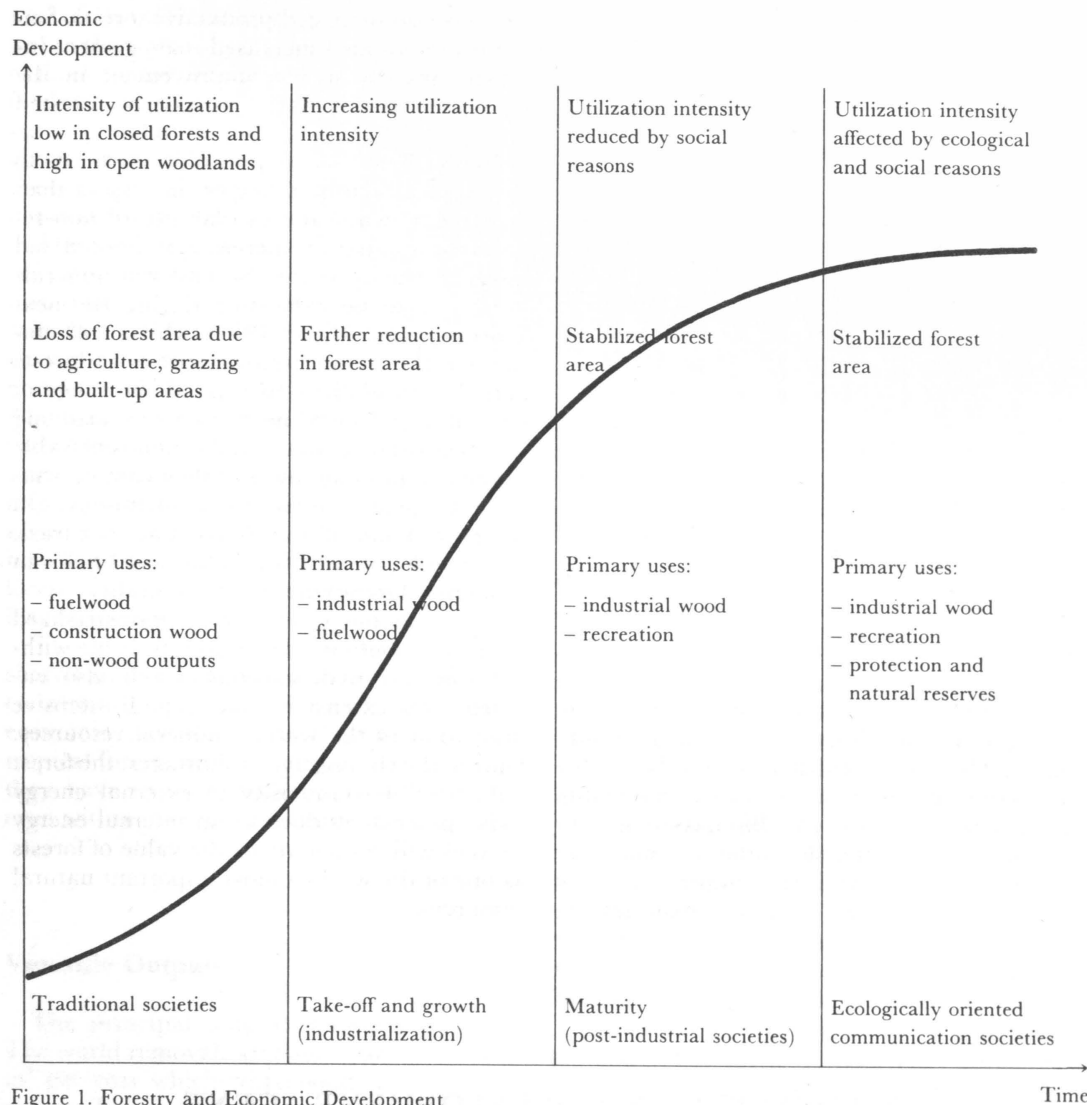


Figure 1. Forestry and Economic Development

1962). The sectorial growth effects are even more important, as they contribute to regional equality, particularly in remote areas difficult to develop otherwise.

Forestry's contribution to economic development is derived from increased wood production and subsequent industrial activity. Such change is, however, difficult to realize, as far-reaching changes in the cultural tradition and social structure of the spec-

ulative rural communities are often necessary. Riihinen (1981) has pointed out that a certain efficiency in production is necessary (outputs have to exceed inputs), otherwise investment is not possible and autonomous development does not follow.

A precondition for development is that the sequence described in Figure 2 can be initiated, e.g. by investments. The necessary social change is always slow and furthermore its

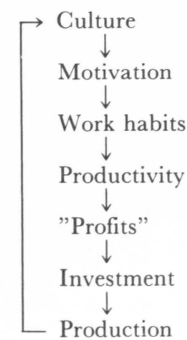


Figure 2. Cycle of Autonomous Development (Source: Riihinen 1981).

desirability has been questioned on other than economic grounds. On the other hand, many governments, for political reasons, have had difficulties in facing the problem due to the apparent conflict between short-term and long-term interests. Furthermore, in countries with extensive resources, forests have often been considered as a source of capital which needs no reinvestment. In many exporting countries, government tax revenues from forest utilization and wood exports are an important source of funds difficult to replace from other sources.

Change in Development Strategy

In accordance with the general growth strategy, a strong case for the industrialization approach to forestry in the developing world has prevailed during the post-war years. The strategy was formulated by Westoby (1962) and it was adopted by many countries and aid agencies.

Forestry was seen as a economic activity which could bring along development in other sectors as has happened e.g. in the Nordic countries (locomotive theory, cf. Riihinen 1981). However, experience has shown that the role of fuelwood must not be neglected and forestry development is highly interdependent on the other sectors of the economy, as well as social and political aspects.

Slow growth rates were later explained by dependency theory, i.e. the rich countries are the reason for underdevelopment in the poor countries (e.g. Westoby 1978). In forestry, this is more difficult to justify than in manufacturing, or even in agriculture at the global level, apart perhaps from those countries which have been important exporters of tropical logs. According to the neo-Westobian view in many developing countries governments are lacking genuine interest in improving the living conditions of the poor. The proposed new objective is the production of agricultural surplus and the role of forestry is first to support the traditional rural sector and then satisfy national needs for forest products. Low priority should be given to the establishment of export-oriented industries which are often capital intensive large-scale operations using sophisticated technology, particularly in pulp and paper production.

Poverty in Focus

The causes of poverty are rooted in a complex web of economic, social, political and geographic factors. The fundamental man-land relation is characterized by overpopulation, lack of access to land, and very small-sized farms (Jacoby 1971). Forestry can have only limited impact on development as long as land reforms are not implemented, land tenure is not clarified, and the rural population is not offered a real opportunity to participate actively in the development process and it is educated to implement the necessary tasks. There is a general consensus among international aid organizations that the main problem is a lack of involvement of, and benefit to, the rural poor in the mainstream of forestry activities. This is reflected in the aggravation of forests land management problems and of the income gap constraint on development (Douglas 1983). It is apparent that environmental considerations tend to have a low priority in the decision-making on budget allocation in the developing countries if they are not of an immediate nature.

Based on these grounds, FAO has given priorities in forestry development to the improved supply of fuelwood, rural building

materials and various minor forest products (medicinal plants, fruits, fodder, etc.). The elements of the new strategy include integration of forestry with agriculture, voluntary participation of local communities in forest management and the use of appropriate technology (FAO 1980). Political willingness is implicitly assumed, while the World Bank (1978) is more pragmatic giving priority to projects directed at rural forestry, but at the same time they recognize that political factors are essential preconditions of change.

With the faltering of the debate on a new

international economic order, the developing countries are advised to adjust themselves to the existing international order rather than waiting for the international order to adjust to their needs (Emmerij 1983). In this process forestry offers alternative and flexible strategies, as it can be practiced either as a large-scale operation for industrial purposes or as a small-scale rural-based activity, or both; it offers strong environmental benefits; and its decision-making processes can be largely decentralized contributing to local self-reliance.

3. FORESTS AS AN ENVIRONMENTAL ASSET

The main tasks of forests in the environment are related to the energy, oxygen and carbon cycles of the biosphere, to the habitat of plant and animal species, to soil conservation and watershed management, and to esthetic and amenity values.

The energy that sustains all living systems is solar energy. Vegetation utilizes this energy in photosynthesis where it is held in the biosphere before being reradiated into space as heat. The total amount of solar energy fixed sets one limit on the total amount of life. A substantial change in the forest cover, e.g. through deforestation, disturbs these biotic cycles which, it is feared, will be reflected in changes of climate even on a global scale. To what extent the long term increase in atmospheric carbon dioxide is due to deforestation has not been scientifically measured and estimates vary extensively (Woodwell et al. 1983). Far more evident are the negative effects on microclimate at local level in deforested areas.

In world forestry there are two forces working towards the reduced biotic diversity of the flora and fauna, deforestation and intensive forest management often based on monocultures. In this respect forests are not renewable as extinction is irreversible. Dramatic projections have been presented on the rate of species extinction (e.g. Global 2000) but available scientific research is far from comprehensive. The concern is certainly justified

but much more research is needed before exact conservation targets for tropical forests can be established. In temperate forests the problem is less complex but its magnitude remains to be measured.

Deforestation leads inevitably to the disruption of water systems resulting in landslides in the mountains, siltation of reservoirs and irrigation areas, increased flooding, etc. The problems are regional or local but concern hundreds of millions of people – their source of living and health. Costly flood control programs in the downstream have proved useless when forests no more provide sponge effect to regulate streamflows.

The environmental role of forests to the mankind is as fundamental as the provision of wood-based products. To ensure that the forests will provide the necessary environmental services in the long term future

- necessary areas should be earmarked for conservation of the genetic pools and these decisions should be backed up by sufficient scientific research;
- the common property problem of natural forest management (cf. Hardin 1968) should be solved through institutional and regulatory measures;
- forest clearing in catchment areas and fragile ecosystems is discontinued;
- external benefits derived from forest plantations should be taken into account in the appraisal and evaluation of irrigation and hydroelectric projects; and

Table 3. Major Future Environmental Impacts of Excessive Forest Exploitation.

| Level | Terrestrial | Atmospheric | Aquatic |
|----------|---|--|---|
| Global | Extinction of species of plants and animals, particularly in the tropics; and reduced biotic diversity | Deforestation leads to loss in carbon dioxide absorption and retained CO ₂ in the biomass is released | Impact unknown |
| Regional | Deforestation in the tropical forest areas; reduced biological diversity | Movement of dunes; hot dust-laden winds | Deforestation and land clearing alter the hydrology of major rivers, exaggerating extreme high and low flows; changes of aquatic life in mangrove zones |
| Local | Critical catchment areas and inherently unstable land will become destabilized leading to erosion and land slippage | Noticeable increase in humidity near reservoirs and irrigation systems | Local streamflows and seasonal floods increase in basins with deforested watersheds; reduction in groundwater supplies and increase in vulnerability to drought; silting of dams and reservoirs |

Source: Adapted from Global 2000

- in forest management: halt deforestation, extend the forest area by plantations, increase the stocking of existing forests, favour high density woods if exploitable, maintain secondary vegetation as far as possible, maximize soil organic matter, and combat forest fires (Spears 1979).

At the global level the main environmental impacts of forest exploitation (Table 3) are related to the extinction of species and large-scale deforestation in the largest untapped forest resource areas, particularly in the tropics, notably the Amazon Basin and the Congo River Basin. Equally important is the representation of many typical ecosystems in selected localities. Development of a global network of protected areas as planned under MAB (UNESCO) and FAO programmes seems a good approach, which may be further strengthened. Countries tend to consider their forestry as a part of their national heritage, to be used to reach their own objectives. With very little information available on the global relationships between forest and macroclimate and the distribution of the world's

genetic resources it is difficult to see how individual countries could sufficiently take into account global implications of the utilization of their resources. Massive research efforts are needed. The current international institutional arrangements should be strengthened with this objective in mind.

In the developed countries, forests are endangered by industrial pollution. The main reason for the degradation of the forest resources in Central Europe, the southern part of the Nordic countries and Canada is believed to be acid deposition originating from sulfur and nitrogen oxides chemically transformed in the atmosphere and falling to earth as rain, snow, fog, or particles. These so-called acid rains effect trees directly or through reduced soil pH. The exact reasons for massive forest degradation have not yet been scientifically established. The problem is very complex and time-consuming to study. Net pollution exporters have favoured policies which involve the study of the problem before regulation measures are introduced, while net importers have been advocating immediate action to reduce air pol-

lution emissions from energy generation, industry and traffic. The Federal Republic of Germany, where the effects are now well monitored, is an exception and has taken important measures to reduce emissions.

There appears to be very little doubt that air pollution regulations have too much favoured short-term economic interests the cost of which will first be borne by the reduction of forest quality and wood quantity. Necessary action to invest in air pollution abatement may not be justified based on purely short-term economic grounds but fortunately strong popular movements have emerged to prepare the ground for political

decisions. While the direction of the necessary action is not questionable, lack of scientific evidence on the specific role of individual pollutants should not be an obstacle to establish international action and mechanisms to improve the situation. The economic costs of delaying action may be enormous and far-reaching, first affecting the forest products industries. In the industrialized countries, acid rain is probably the most important forestry problem to be solved during the coming decades, but it is not limited to forests alone as trees may serve only as the tip of an iceberg representing the health of the whole biosphere including man himself.

4. DEFORESTATION IS A SOCIAL PROBLEM

Reliable data on the rate of deforestation which takes place in the tropics is lacking but the most comprehensive analysis carried out so far concluded that about 11.3 mill. ha of closed forest and open woodland are lost annually (Lanly 1982). This corresponds to an average rate of 0.6 per cent per year which would mean that about a tenth of the tropical forest area would be lost by the end of the century. The process is most rapid in South and Central America and in the African savannahs and other open woodlands (Table

4). The regional averages hide wide variations by countries and by regions within countries. In West Africa, the rate of deforestation is estimated at 4 to 6 per cent per year, having a detrimental effect on the living conditions of the local populations. Similar alarming situations occur in many other regions, such as the densely populated East African countries, the Peruvian Andes, the Philippines, Peninsular Malaysia, Nepal, Northeastern India, etc.

The deforestation process is associated

Table 4. Average Annual Deforestation in the Tropical Regions 1981-1985.

| Source/Region | Closed forest | Open tree formations | Total |
|---|---------------|----------------------|-------------|
| | - mill. ha. - | | |
| Shifting cultivation and secondary formations | 3.4 | 1.7 | 5.1 |
| Permanent agriculture, shrub, brush, grasslands, other uses | 4.1 | 2.1 | 6.2 |
| Total | 7.5 | 3.8 | 11.3 |
| of which | | | |
| Tropical America | 4.3 | 1.3 | 5.6 |
| Tropical Africa | 1.4 | 2.3 | 3.7 |
| Tropical Asia | 1.8 | 0.2 | 2.0 |

Source: Lanly 1982

with the sociological factors governing the relationship between rural dwellers, land use and the forest itself (Douglas 1983). The main reasons can be derived from population growth and density as well as rising incomes, and therefore deforestation should be considered primarily as a social problem. The main single reason is shifting cultivation. With a low population density, it does not necessary represent an ecological threat but with increasing population pressure, the fallow period shortens leaving not enough time for the vegetation to recover.

Many other reasons for deforestation are also related to agriculture such as overgrazing and clearing land for permanent cultivation, grasslands, etc. The problem here is that soil productivity surveys are not carried out and if the cleared areas cannot sustain permanent agriculture they are abandoned and changed to valueless shrub formations or brush. Cultivation has to move to new areas which means further deforestation. Coupled with population growth the increasing need for heat and shelter has created such a demand for fuelwood and construction wood that in many open forest lands wood collection efficiently finalizes the depletion of forest resources. Some areas of natural forest are

lost for deserts, cities, dams and forest plantations.

The most efficient means of counterattack deforestation would be related to controlling the growth of rural population and eradicating poverty. Other actions include land-use planning and control, which often remain ineffective if not coupled with necessary supporting activities. In most cases shifting cultivators are landless peasants which are more or less entitled to use unoccupied land. Much of the deforestation problem may be the result of its common property characteristics which should be solved through institutional measures.

It is difficult to see regulatory or control measures becoming effective in the poor rural areas if the population is not offered alternative and increased income either through higher agricultural and forestry output, or various rural industries. Forestry can play a significant role in generating this additional income derived from silvicultural and logging operations and small-scale wood industries. Intermediate external financing is often necessary to ensure that local populations can survive during the necessary transition period, normally from five to ten years.

5. TROPICAL FOREST MANAGEMENT - UNPROVEN TECHNOLOGY

The tropical countries consider their indigenous forests primarily as an asset which can play an essential role in improving the wellbeing of their populations. International efforts to emphasize the need for conservation from the global viewpoint will lead to results when the threats of forest degradation at global and national levels are increasingly recognized. There is, however, little doubt that the bulk of the remaining tropical moist forests will be subject to some kind of utilization. From the ecological point of view it is crucial which principles are applied in their management. It has been estimated that each year about 4.4 mill. ha of tropical forest is subject to selective logging which creates

some sort of degradation of forest cover, the extent of which depends on the volume removed and logging methods.

The soils of tropical forests are mostly infertile and plant nutrients are held in the biomass rather than in the soils. Selective logging has a less permanent and irreversible effect on the tropical forest than agriculture, even though logging may cause substantial damage to the remaining vegetation. More serious is the impact of opening up new areas for the encroachment of shifting cultivators through the building of access roads. Logging in steep slopes and catchment areas leads directly to negative ecological effects.

The heterogeneity of tropical forests and the

limited market possibilities in terms of species which can be harvested give low commercial yields per area unit and have led to utilization of extensive areas. The quality of second-growth forest is largely unknown. The ecological impacts should be particularly studied and the economic possibilities to utilize the cut-over areas depend to what extent markets can be found for lesser-used species.

Because of the complexity of tropical moist forest ecosystem the best methods of sustained-yield management, the fundamental principle in forestry, still remain to be developed. As only little silvicultural treatment

6. THE ENERGY CRISIS IN THE LDC'S IS A FUELWOOD CRISIS

In 1980 approximately 2000 mill. people, i.e. three quarters of the population of the developing countries, depended on fuelwood and other traditional fuels for their daily domestic energy needs. About 100 mill. people were unable to satisfy their minimum energy needs. A further 1050 mil. rural people live in situations with growing deficits where minimum needs are met at the cost of depleting the existing resources. The situation is deteriorating rapidly as FAO forecasts that in 2000 about 3000 mill. people would suffer from acute scarcity or deficit of fuelwood in the developing countries (Table 5). The situation is worst in Asia but difficult also in Africa and many parts of Latin America and most of the Near and Middle East (FAO 1981b). The hardest hit regions are arid and semiarid zones, mountainous areas and densely populated areas depending on open woodlands. Some countries, particularly in Africa, are almost entirely dependent on fuelwood as a source of energy. The overall dependence is slowly reducing but it is not affecting rural populations (Montalembert-Clément 1983).

In the low-income regions, the sequence of the fuelwood crisis starts with population growth leading to higher consumption. As available resources within reasonable collection and transport distances (about 10 and 50 km, respectively) are depleted, shortages arise leading to price increase and use of

is currently carried out in these forests, improvement is badly needed. The viable solutions are likely to represent a wide range and each region and type of forest have to be studied separately.

The national public forest administrations will play a key role in this development, but their efforts are hampered by the lack of necessary research and budgetary pressures. The current research efforts are far from sufficient and without international action, very little real improvement is foreseen during the next few decades, presumably the critical period.

alternative fuels, particularly cow dung (Arnold & Jongma 1978).

This reflects in lower soil productivity leading to reduced agricultural production and further to malnutrition and higher mortality. At the same time, productivity in fuelwood collection declines. E.g. in the arid Sahelian zone a full man-year is required to collect the fuel needs of a household. Those depending on purchased fuelwood will suffer from soaring prices through reduced consumption possibilities for other basic needs. Under these circumstances it is very difficult to control deforestation. The whole process tends to be

Table 5. Populations Experiencing a Fuelwood Scarcity and Deficit 1980-2000.

| | 1980 ¹⁾ | 2000 |
|-----------------------|--------------------|-------|
| | - millions - | |
| Africa and Near East | 417 | 803 |
| Asia and Pacific | 1 024 | 1 671 |
| Latin America | 277 | 512 |
| Total | 1 718 | 2 986 |
| Share of population % | | |
| - LDC's | 52 | 62 |
| - World | 39 | 49 |

1) Including prospective deficit
Source: Montalembert-Clément 1983

self-accelerating leading to lower and lower sustainable population per area unit in the long run.

Technical Solutions Are Not Sufficient

There are a number of tested promising solutions for the fuelwood crisis which, however, have gained only limited momentum until today as necessary financial inputs have been difficult to attract by the subsistence sector on a required scale. These solutions include (cf. Montalembert-Clément 1983):

- improved efficiency of fuel use replacing open fires with stoves which can save up to 70 per cent of fuel consumption; sufficient educational programs are necessary to create change in this most promising option, and the provision of building materials and techniques for stoves is needed;
- the establishment of fuelwood plantations; even if financing can be arranged the programs have suffered from the lack of necessary institutional framework to implement large-scale schemes, as well as from social problems which have not been duly addressed at the preparation stage;
- replacing fuelwood by charcoal when transport distances are too long to transport fuelwood economically; this can, however, contribute to uncontrolled deforestation in the production areas when charcoal is sold to large urban centers with vast markets;
- switch to other fuels easier to use than fuelwood (kerosene) as soon as income levels permit it, particularly in the urban areas; and

- promote the use of other alternative sources of energy such as biogas, solar and wind energy even though widely applicable technical solutions are not yet apparently at hand.

The fuelwood crisis is a global problem which has to be solved at the local level. The apparent uniformity of the shortage situations, coupled with deforestation, must not be interpreted so that general solutions exist due to various social and cultural factors. The problem can be solved only partly by foresters, and requires multidisciplinary efforts. There is no doubt that the orientation of public forest administrations needs to be changed to implement efficient fuelwood programs.

Wood is also an important fuel in the developed countries and its use is dominated by forest products industries while the household consumption has rapidly declined. The increase in oil's real price in the 1970s' has led to a certain resurgence of wood (and peat if economically available) as an energy source, coupled with technological developments in growing, harvesting and processing wood raw material and biomass in general into suitable fuels. It is certainly unlikely that fuelwood would become a major element in the world's supply of commercial energy but in many regions it may prove to be a significant contributor to the local renewable energy sources (cf. Postel 1984). Its use may be subsidized for strategic reasons if international price relationships do not justify it.

7. FOREST PLANTATIONS AS A FUTURE RESOURCE

The world has only one main option to respond to the growing needs for forest products: plantations. The annual rate of planting in the tropical countries has been about 1.1 mill. ha and in 1985 about 17 mill. ha or one per cent of all natural forests and open woodlands would be planted. Planting has been a standard reforestation method in the developed world for decades. In the mid-1970s' plantations in these areas covered

about 82 mill. ha or 4.3 per cent of closed and open forests (FAO 1978).

In Latin America, industrial plantations cover about one per cent of forest area, but they supply about one third of the region's industrial wood output (McGaughy-Gregersen 1983), which illustrates the potential. The rate of deforestation is, however, about ten times higher than that of plantations in terms of absolute area, and therefore the lat-

ter cannot compensate the ecological damage of deforestation.

Until recently, the emphasis has been on industrial plantations but there is a tendency towards more non-commercial planting, mainly for fuelwood, soil conservation and watershed management. The current planting rates are, however, insufficient to meet the developing world's future fuelwood supply and many-fold increases are needed even if allowance is made for various technological changes in fuelwood consumption, as discussed above.

Plantation forests are likely to complement the wood supply from the natural forests thereby relieving pressure on their use and reducing deforestation in arid and semi-arid zones. Plantations are also needed for purely ecological reasons, e.g. to halt desertification and improve water catchment. The growth rates are mostly rapid averaging perhaps 10 to 20 m³/ha/year on good sites and with well chosen species. The production potential is huge as the availability of suitable lands is not a problem on a global scale. Sedjo (1983)

8. FORESTRY IN RURAL DEVELOPMENT

The experience gained from industrial forest projects during the last few decades has proved that solutions for fuelwood supply and deforestation must be based on another approach. The international agencies are now stressing the need for intergrated multidisciplinary procedures to improve the living conditions of the rural population. This message has, however, penetrated only partly into public administrations at the national level as a basic change is needed in the authorities' attitudes to add capability of mutual coordination and cooperation.

It is apparent that forestry projects, particularly those serving the needs of rural dwellers, can no more be treated as isolated techno-economic undertakings independent from the life of the surrounding communities. The integrated approach means, in practice, a due consideration with regard to the sociocultural background and lifestyles of the local ethnic groups, and combining various

forms of economic activities such as the cultivation of subsistence and cash crops, horticulture, cattle raising, rural industries, etc. Various forms of agro-forestry or land-use systems and technologies, where woody perennials are deliberately used on the same land management unit, offer particularly promising prospects, as the experience from East and West Africa, Central America or Malaysia and the Philippines indicates (Lundgren & Raintree 1983).

The combined land-uses have other important benefits. Labour input requirements can be balanced according to the availability and total employment impacts are high and evenly distributed over seasons compared to specialized production (Svanqvist 1976). The output combinations are flexible and enable the subsistence communities to reach high degrees of self-sufficiency in meeting their basic needs.

There is a widespread consensus among

has estimated that the projected industrial wood consumption in the year 2000 could be met by the sustained yield production of just 100–200 mill. ha of fast-growing plantation forests or no more than 3.5 to 7.0 per cent of the area of the world's closed forests.

Large-scale planting programs represent certain ecological risks related to the overall vulnerability of monocultures and their tendency to reduce biotic diversity in the long run. Latter concern may be exaggerated as the areas to be covered will in any case be limited. No large-scale catastrophes have occurred in tropical plantations but the current evidence on their ecological stability is inconclusive and this aspect should be seriously taken account in planning large-scale industrial plantation programs. On the other hand, the positive effects of artificial reforestation surpass the possible negative impacts where marginal lands are planted. Plantations for the rural needs will be dispersed in smaller lots representing little if any ecological risks. A much more difficult problem is how these plantations can be financed.

the international agencies about the priorities of village forestry as a component in rural development programs and this is reflected in the allocation of funds between industrial and rural forestry projects (e.g. FAO 1981a, World Bank 1978). It is realized that rural development must go beyond the mere obtainment of production targets; the objectives also include the alleviation of poverty and the attainment of social equity and justice (Sauma 1979).

The current mainstream of forestry development strategies may to a certain extent overemphasize the very poorest conditions in

rural areas. This may lead to increasing pressures on the supply of industrial forest products in the urban centers as latent demands are rapidly mobilized. Industrial and community needs for wood may be supplied by the same sites.

The population in forested areas usually represents the lowest income levels in the developing countries. Forests provide these tribal and landless people income, employment and means of subsistence. Forestry development, if well coordinated, can significantly contribute to economic growth as well as better equity of income distribution.

9. FUTURE DEMAND FOR AND SUPPLY OF FOREST PRODUCTS

The world demand for forest products is associated with the overall economic development. Income elasticities are high at the low income levels and low with high incomes. At global level, demand for major product groups (sawnwood, wood-based panels, and paper and board) is increasing but at slower growth rates than in the past. It is not assumed that the consumption potential of the LDC's can be realized and substitution relationships will change radically. The enormous housing deficit in the developing countries would require huge volumes of wood-based building materials but necessary financing will hardly be forthcoming. Paper consumption is also at minimal levels because of high cost and lack of local supply.

In the industrialized countries, the long-term consumption levels of sawnwood have declined since the early 1970's, and in wood-based panels modest increases are projected. The emerging communication societies will not use paper to the same relative extent as in the present transition period. However, paper will always be required and in the medium term, even in increasing absolute volumes. In the long run, however, consumption habits will certainly change, and the developing countries will follow a demand pattern different from that in the industrial world.

There is very little doubt that the world can supply its needs for forest products over the next 20 years, and most likely in the long

run but at a higher real cost than today. The patterns of supply and international trade flows will, however, change. With regard to the raw materials used, the following trends are evident:

- more wood will come from non-coniferous forests due to fast-growing plantations in the developing countries and the unutilized hardwood resources in many industrialized countries;
- more industrial residues will be used as raw material and energy, particularly in the developing countries;
- more waste paper will be recovered, especially in the industrialized countries; and
- annual plants such as sugar cane bagasse, straw, etc. will be increasingly used for paper, mainly in the developing regions.

In the developing countries the value of wood-based exports was USD 9,1 bill. in 1980, falling 10 per cent short of the respective imports (FAO 1983b). The aggregate figures hide substantial net exports in roundwood and wood-based panels, reasonably well-balanced sawnwood trade, and huge deficit in paper and board.

The world trade flows in forest products are characterized by two major net importing regions, Western Europe and Japan who are mainly supplied by North America, the Nordic countries and the USSR in coniferous-based products, Southeast Asia and West and Central Africa in tropical logs and their pro-

ducts. There is a general tendency for the growing role of the developing countries in world trade and they may change from price-takers to price-makers (cf. Sedjo 1983). Another trend is a switch from raw material exports to higher-value added products. Because of the heterogeneity of timber as an internationally traded commodity, there is no possibility for effective cartel arrangements, such as e.g. OPEC, at least in tropical timber. Therefore the recently reached Tropical Timber Agreement gives emphasis to trade promotion, safeguarding future supply, market intelligence, research and development, etc. (UNCTAD 1983). Concrete results from the new arrangements remain to be seen, but as long as market access in converted products is not facilitated by the main importers, who still maintain highly protective tariff structures and various other obstacles, realized development will be slow (cf. Ferguson & Lloyd 1980).

Forest industries are raw material intensive, which favours location of primary conversion close to the forest resources. In pulp and paper production the capital intensity obstacle has not been successfully eliminated even though the developing countries would badly need small and medium-scale mills. Because of the huge size of the projects often reflecting the over-ambitious political aspirations of the LDC governments, many costly efforts have failed. The development of pulp and paper production has become a dilemma for many developing countries.

In the industrialized countries, the forest industries have not enjoyed sufficient profitability in the long term which has resulted in substantial subsidies to the sector in several countries. Slow growth of demand, coupled

10. CONCLUDING REMARKS

There is a need for a global programme for *in situ* conservation of genetic resources, wise management and utilization of existing natural tropical forests with due regard to their long-term productivity, development of ecologically sound intensive forestry cultures to meet the future growing material demands,

with large mill size has increased risks, making structural change more and more difficult. The delayed restructuring has led many countries in Central Europe to shut down the small obsolete mills being unable to build new modern capacity.

Paper is a major source of residential and commercial waste in modern societies. It has been estimated that in the United States about half of the total gross discards of non-food items would be paper (Global 2000). Only 14 to 17 per cent of paper consumption cannot, however, be recovered for re-use. In the early 1980's almost a third of the total consumption was recovered as waste paper and it accounted for 30 per cent of the total fiber used in paper-making in 34 major countries (FAO 1983a). The paper industry relies on a renewable resource and it further recovers about a third of its end products for re-use as fibrous raw material. In the long run the recovery rate is likely to increase and it is projected to be in the range of 35 to 40 per cent of consumption at the end of the century. In Japan, the Netherlands and Switzerland the rate is already 44 to 48 per cent, which illustrates the magnitude of the potential.

The pulp and paper industry can be an important source of water and air pollution. Nonetheless, these problems can be avoided by proper mill design and operation coupled with adequate treatment and disposal of objectionable air or water emissions at reasonable extra costs. Because of the importance of international trade in the industry, it is necessary to harmonize respective legislation. Lack of such regulations cannot, however, be an excuse to build and run mills which may cause irreversible damage to their environment as is sometimes the case.

development of planning practices for rehabilitation of fragile ecosystems, and, above all, integrating forestry with peoples development with focus on poverty.

Forestry has traditionally been considered as a subsector where development problems have largely been left for professionals. The

ecological consequences of deforestation and the catastrophic effects on forests of acid rains have awakened the public and the international scientific community to realize the versatile value of forests to the mankind. The doomsday trend line projections of the complete disappearance of the world forests are naive but they are convincing political decision-makers that there is less conflict between economic and ecological benefits and that the long-term problems may have to be faced sooner than anticipated. Forestry clearly deserves a higher priority than in the past.

The problem is global, but solutions are national and local. An international forest policy which covers both the developed and developing countries is needed. It cannot be formulated and adjusted without reliable information on the world's forests and the demand for and the supply of their outputs. In particular, scientific knowledge on tropical forests should be rapidly increased. Continuous monitoring is necessary and the resource allocation of the relevant international organizations should be revised to reflect the high priority of global analyses. Methodological tools are already being improved to respond the future needs (e.g. Dykstra-Kallio 1984).

One of the key issues to be determined at the international level is that mankind should decide – and the decision has major interna-

tional implications – on a policy towards the remaining natural forests: whether to preserve them in their virgin states; if so, how much of them, where and how (Peck 1984).

Many of the world's forestry problems are in fact social issues which have to be addressed by coordinated multidisciplinary approaches, not only at the level of planning but also in implementation and its organization. Many development programs have not reached those they are supposed to help. The reason is probably a fundamental social and cultural bias in public administrations at various levels. Development should be generated, not imported. The art of technical assistance assumes technical skills as a necessary but far from sufficient requirement. At international level, bureaucracies are so heavy that aid giving efficiency appears only concern a few.

Long-term sustained economic development is possible only if it is ecologically sound (Giarini 1983). This principle has been the basis of scientific forest management for decades. In sectoral resource allocation, forestry's intergenerational benefits have not been seriously considered, and external net benefits, particularly those related to social and environmental aspects, have been largely ignored. These shortcomings of economic analyses represent a high bill to be paid by future generations.

REFERENCES

- Arnold, J. E. M. & Jongma, J. 1977. Fuelwood and Charcoal in Developing Countries. *Unasylva* 29 (118): 2–10.
- Beardsley, W. H. 1976. Commodity and Material Needs: Forestry in an Age of Shortages. *Journal of Forestry* Febr. 1976: 71–74.
- Douglas, J. J. 1983. A Re-Appraisal of Forestry Development in Developing Countries. The Hague.
- Dykstra, D. & Kallio, M. 1984. A Preliminary Model of Production, Consumption and International Trade in Forest Products. International Institute for Applied Systems Analysis. Laxenburg.
- Emmerij, L. 1983. Trends in International Development and Security. *Development* 1983 (1): 5–12.
- FAO. 1978. Development and Investment in the Forestry Sector. FO:COFO-78/2. Rome.
- FAO. 1980. Towards a Forest Strategy for Development. COFO-80/3. Rome.
- FAO. 1981a. Agriculture towards 2000. Rome.
- FAO. 1981b. Map of the Fuelwood Situation in the Developing Countries. Rome.
- FAO. 1983a. Waste Paper Data, 1980–82. FAO Advisory Committee on Pulp and Paper. FAO:PAP/83/4. Rome.
- FAO. 1983b. Yearbook of Forest Products 1970–81. Rome.
- Ferguson, I. S. & Lloyd, P. J. 1980. Non-tariff Distortion of International Trade in Forest Products. *Unasylva* (130): 2–9.
- Giarini, O. 1982. Dialogue on Wealth and Welfare – An Alternative View of World Capital Formation. The Global 2000 Report to the President. 1980. Council on Environmental Quality and the Department of State. Washington, D.C.
- Hardin, G. 1968. The Strategy of Commons. *Science* 162: 1243–1248.

- Jacoby, E. H. 1971. Man and Land. The Fundamental Issue in Development. Tonbridge.
- Lanly, J. C. 1982. Tropical Forest Resources. FAO Forestry Paper 30. Rome.
- Lundgren, B. O. & Raintree, J. B. 1983. Sustained Agroforestry. ICRAF. Nairobi.
- McGaughey, S. & Gregersen, H. M. 1983. Forest-Based Development in Latin America. Inter-American Development Bank. Washington, D.C.
- de Montalembert, M. L. & Clément, J. 1983. Fuelwood Supplies in the Developing Countries. FAO Forestry Paper 42. Rome.
- OECD. 1979. Interfutures. Paris.
- Peccei, A. 1982. 100 pages for the Future.
- Peck, T. 1984. The World Perspective. In Hummel, F.C. (ed.): Forest Policy. A Contribution to Resource Development. The Hague.
- Postel, S. 1984. Protecting Forests. In Brown, L. R. (ed.). State of the World. Worldwatch Institute. New York.
- Riihinen, P. 1981. Forestry and the Timber Economy in Economic Development. *Silva Fennica* 15 (1981): 2, 199-202.
- Saouma, E. 1979. Statement at UNCTAD V, Manila, 14 May, 1979.
- Sedjo, R. A. 1983. The Comparative Economics of Plantation Forestry: A Global Assessment. Resources for the Future Inc. Washington, D.C.
- Sedjo, R. A. & Clawson, M. 1983. Global Forests. Washington, D.C.
- Spears, J. S. 1979. Can the Wet Tropical Forest Survive. *Commonwealth Forestry Review* 58 (3), 165-180.
- Steinlin, H. 1979. Die Holzproduktion der Welt. Ökologische, soziale und ökonomische Aspekte. *Schweizerische Zeitschrift für Forstwesen* 130 (2): 109-131.
- Svanqvist, N. 1976. Employment Opportunities in the Tropical Moist Forest Under Alternative Silvicultural Systems Including Agrisilvicultural Techniques. FAO. Rome.
- UNCTAD. 1983. International Tropical Timber Agreement, 1983. TD/TIMBER/11. Geneva.
- Westoby, J. C. 1962. Forest Industries in the Attack of Under-development. The State of Food and Agriculture FAO. Rome.
- Westoby, J. C. 1978. Forest Industries for Socio-economic Development. 8th World Forestry Congress. Jakarta.
- World Bank. 1978. Forestry Sector Policy Paper. Washington, D.C.
- Woodwell, G. M., Hobbie, J. E., Houghton, R. A., Melillo, J. M., Moore, B., Petersen, B. J. & Shave, G. R. 1983. Global Deforestation: Contribution to Atmospheric Carbon Dioxide. *Science* 222 (4628): 1981-1986.

Total of 36 references

SELOSTE

METSÄTALOUS JA KEHITYS - GLOBAALINEN NÄKÖKULMA

Maailman metsätalouden tärkeimmät ongelmat liittyvät teollisuusmaissa ilman saastumisen vaikutukseen metsiin sekä siihen, kuinka puuhun perustuvien hyödykkeiden kysyntä voidaan tulevaisuudessa tyydyttää erityisesti havupuun osalta. Kehitysmaiden pitäisi pystyä estämään ihmisen aiheuttama metsien häviäminen samalla kun metsätalouden mahdollisuudet edesauttaa taloudellista ja sosiaalista kehitystä pitäisi käyttää täysin hyväksi.

Metsätaloutta on perinteisesti pidetty kansallisena kysymyksenä, joka vain verraten harvoin on saanut osakseen poliittisten päätöksentekijäin huomion. Negatiivisia kehityssuuntia on ollut sen vuoksi vaikea muuttaa. Keskeisistä metsätalouden tavoitteista tulisi vallita yhteisymmärrys koko maailmanyhteisön kesken. Geenistön säilyttämistä, trooppisten luonnonmetsien hyväksikäyttöä, ekologisesti turvallisten metsänhoidon ja -käytön menetelmiä sekä metsätalouden ja sosiaalisen kehityksen yhdistämistä koskevat yhteiset tavoitteet ohjaisivat epäsuorasti kansallisella tasolla tehtäviä päätöksiä nykyistä terveempään suuntaan. Ristiriita lyhyen aikavälin taloudellisen edun ja ekologisen kehityksen välillä on lievenemässä, sillä ympäristötekijät muodostavat pysyvän taloudellisen hyvinvoinnin perustan.