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Most issues of Unasylva focus on a specific theme. The objective of this thematic orientation is to examine in depth a given aspect of forest and forestry development in order to highlight its significance and importance within our wider universe. The aim is not to serve as a primer or textbook on the chosen subject (this clearly would be impossible given the limited size of the journal) but rather to present a series of analyses on specific aspects that help to spark interest and awareness. These articles are commissioned from experts in the sector, based on the recommendations of the Unasylva Editorial Advisory Board. The articles have been tailored in such a way as to be of interest and relevance to readers whose work focuses on the theme in question as well as to the majority of readers who are experts in other disciplines.

Complementing the articles focusing on a given theme, each issue of Unasylva also endeavours to provide space for independent articles, often received as voluntary contributions from our readership. This function is seen as a forum for expression, a fundamental part of the journal’s mandate. And yet, the complexity of the thematic issues addressed has often required the inclusion of many articles within the thematic focus, leaving relatively little space for independent articles. This creates a situation where independent articles are either not published or are published as much as a year after they are submitted. Therefore, after a World Forestry Congress Dossier, containing the Antalya Declaration, plus the opening addresses by Ersin Taranoglu, Turkish Minister of Forestry and Congress Chair, Jacques Diouf, FAO Director-General, and Süleyman Demirel, President of Turkey, this issue of Unasylva is dedicated to voluntary contributions.

The first article, by J.J. Kennedy, M.P. Dombeck and N.E. Koch, considers changing perspectives on the management of state-owned forests, arguing strongly for a broader, more holistic approach. The analysis is rendered even more interesting by the fact that, since its submission to Unasylva, co-author Michael Dombeck has been named Chief of the United States Department of Agriculture Forest Service.

Budget crises are leading to reduced public expenditures in the area of forestry research in many countries around the world. The potential of private investment as a complement to or even a substitute for public spending is often considered – but generally in a theoretical fashion. The article by E. Hellström, M. Palo and B. Solberg uses empirical findings from two European studies to take a close look at the situation. The authors conclude that private investment cannot and should not be expected to substitute for public funding, and they make recommendations as to how support for public funding of forestry research could be boosted.

The rate of tropical deforestation is one of the foremost concerns in the world of forestry today. Determining this rate requires accurate current information as well as valid historical records. The article by J. Fairhead and M. Leach suggests that, primarily owing to imprecise estimates of past forest cover, current estimates of West African deforestation over the course of the twentieth century may be significantly exaggerated.

The rest of the articles in this issue of Unasylva are adaptations of voluntary papers submitted to the Eleventh World Forestry Congress. This is part of the commitment made in the previous issue of the journal to tap the wealth of information produced for the Congress, particularly the best of the voluntary papers, which might not otherwise receive the attention they merit.

The role of forest plantations in helping to attain sustainable forest management overall is the subject of intense debate. There is little doubt that future supplies of forest products will come increasingly from intensively managed plantations. One fundamental question regards the requirements to enable plantations to produce supplies of constant quantity and quality over time. The article by J. Evans reviews available evidence and reports recent findings from a comparison of three successive rotations of pine in the Usutu Forest, Swaziland.

The article by C. Barthod puts into perspective discussions on criteria and indicators for sustainable temperate forest management. Focusing on experiences since 1992, the article discusses outcomes of the Helsinki and Montreal Processes, including challenges that have been identified but not yet resolved.

The importance of cultural factors in identifying criteria and indicators is highlighted. S.T. Murphy reviews the impact of pests on forestry and agroforestry in Africa and current control actions.

The article concludes with a proposal for a coordinated regional approach, based on the recommendations of an International Consultative Meeting of Forestry Directors and Policy-Makers, convened in Kenya in 1995.

The final article, by R. Carneiro de Miranda, analyses the theory and practical application of forest replacement schemes in Latin America, a model aimed at achieving a sustainable and ecologically sound supply of fuelwood for industrial consumers.

With the next issue, Unasylva will return to its thematic orientation, focusing on the objectives and outputs of the Global Fibre Supply Study currently being conducted by FAO. However, Unasylva continues to solicit articles as well as feedback from its readers and, periodically, future issues will again be dedicated to voluntary contributions. Readers are reminded that Unasylva is available in electronic form on the Internet at: http://www.fao.org/waicent/faoinfo/forestry/unasylva/default.htm. Comments or articles may also be submitted via e-mail to Unasylva@fao.org.
The Eleventh World Forestry Congress took place from 13 to 22 October 1997 in Antalya, Turkey. The general theme of the Congress was “Forestry for Sustainable Development: Towards the Twenty-first Century”. More than 4,400 participants from 145 countries attended the Congress, representing the scientific community, governments, international organizations, non-governmental organizations (NGOs) and the private sector. During the nine-day conference delegates attended eight plenary sessions and 43 technical sessions.

The technical sessions were organized around eight main programme areas: Forest and Tree Resources; Forests, Biological Diversity and Maintenance of Natural Heritage; Protective and Environmental Functions of Forests; Productive Functions of Forests; Economic Contribution of Forestry to Sustainable Development; Social Dimensions of Forestry’s Contribution to Sustainable Development; Policies, Institutions and Means for Sustainable Forestry Development; and Ecoregional Review.

In addition to these sessions, three pre-Congress satellite meetings, an informal ministerial meeting and approximately 30 side meetings took place in connection with the Eleventh World Forestry Congress. The Congress produced recommendations and conclusions from each technical session and programme area and the Antalya Declaration.

The general theme, “Forestry for Sustainable Development: Towards the Twenty-first Century”, was established in view of the opportunity to undertake initiatives in the follow-up to discussions of global forest issues at the Intergovernmental Panel on Forests and the Nineteenth Special Session of the UN General Assembly (UNGASS). The Congress aimed to provide a forum for the forestry sector to discuss technical responses; identify actions to be taken and take stock of the state of forestry at the interregional, regional and national levels; respond to challenges; and consider new ways of orienting forestry towards sustainable development in the twenty-first century.

It was an accomplishment that such a large number of participants came together and engaged in discussions on a wide range of topics related to forests, although some participants felt that there was limited opportunity for the synthesis and analysis of some of the key unresolved issues in the forestry debate.

Overall, however, the Congress provided a forum for much-needed dialogue between forestry practitioners, scientists and policy-makers, and it brought together an unprecedented number of participants to share an impressive array of research and ideas about implementing sustainable forest management on the ground. This interchange will undoubtedly bear fruit in the form of further research and collaboration and an improved understanding of ecosystems and techniques for the implementation of forestry for sustainable development in the twenty-first century.

The above analysis is drawn from a special edition of Sustainable Dimensions, a newsletter published by the International Institute for Sustainable Development, financed by FAO. The complete issue of Sustainable Dimensions is accessible on the Internet at http://www.iisd.ca/linkages/sd/antalya/sdvol10no4e.html

This issue of Unasylva contains the full text of the Antalya Declaration as well as the opening addresses by Ersin Taranoglu, Turkish Minister of Forestry and Congress Chair; Jacques Diouf, FAO Director-General; and Süleyman Demirel, President of Turkey. Complete copies of the Congress proceedings may be accessed on the Internet at http://www.fao.org/waicent/faoinfo/forestry/wforcong/publi/default.htm#top) or purchased through the Turkish Ministry of Forestry, T.C. Orman Bakanligi, Dis iliskiler ve AT Dairesi Baskanligi, Atatürk Bulvari 153, 06100 Bakanliklar, Ankara, Turkey.
ANTALYA DECLARATION
Forestry for Sustainable Development: Towards the Twenty-first Century

We, the 4,417 participants from 149 countries gathered in Antalya, Turkey, 13 to 22 October 1997, from ministers to field technicians, from many disciplines and backgrounds, from governmental and non-governmental organizations and other major groups concerned about the state and future of the world’s forests and the need to improve their management for the benefit of people:

Underscoring that all types of forests provide crucial social, economic and environmental goods and services to the people of the world and contribute to food security, clean water and air, and soil protection, and that their sustainable management is essential to achieving sustainable development;

Recalling the “Statement of Forest Principles” and the forest-related chapters of Agenda 21 adopted by the UN Conference on Environment and Development (UNCED) in June 1992 in Rio de Janeiro;

Recognizing the significant progress made since UNCED through national, regional and international initiatives to assess the state of the world’s forests and better understand and advance sustainable forest management, but also recognizing the pressing need for further action both within and outside the forest sector, including agriculture, energy, water and population;

Noting with alarm the continued rapid rate of forest loss and degradation in many regions of the world and emphasizing that reversing this trend and achieving sustainable forest management worldwide depends first and foremost on increased political will by all countries at the highest levels;

Noting in particular the proposals for action recommended by the UN Commission on Sustainable Development’s Intergovernmental Panel on Forests in February 1997, which reflect a balanced, holistic and integrated approach to sustaining the multiple benefits of forests;

Welcoming the decision by the UN General Assembly Special Session in June 1997 (“Rio plus 5”) to establish the Intergovernmental Forum on Forests to promote implementation of the Panel’s proposals and continue the international dialogue;

Acknowledging the informal meeting of ministers responsible for forests hosted by the Government of Turkey in Antalya, 13 October 1997;

Call on:

1. Countries to demonstrate increased political will to overcome the obstacles to achieving sustainable forest management;

2. Forestry professionals to respond to the changing needs and challenges of achieving sustainable forest management and take the lead in creating environmental, social and economic awareness, adjusting education curricula, promoting participatory forest
planning and decision-making processes by all interested parties, and enhancing training of forestry professionals and field staff, with particular attention to the role of women and youth.

3. Countries, international organizations, and major groups to work together to implement the proposals for action agreed by the Intergovernmental Panel on Forests and ensure that further international forest policy dialogue and associated actions, within the Intergovernmental Forum on Forests and other policy fora, continues to be based on openness and transparency;

4. Countries and the international donor community, especially the international financial institutions, to more effectively contribute to and enhance the mobilization of domestic and international financial resources and environmentally sound and appropriate technology transfer, on preferential terms as mutually agreed, to build the capacity of developing countries and countries with economies in transition to better inventory, assess, monitor and manage their forests in a balanced and sustainable manner for multiple benefits, including through the wider use of joint ventures and public-private partnerships, especially joint implementation programmes;

5. Countries and international organizations to adopt a cross sectoral approach to national policies for forests, agriculture, energy, water, soils, mining, transportation and rural development which recognizes that many of the causes, and therefore solutions, to deforestation and forest degradation lie outside the forest sector;

6. Countries, international organizations and forestry professionals to work in open and participatory partnership with all interested parties, including non-governmental organizations, the private sector, indigenous people, forest dwellers, forest owners, local communities and others affected by forest and other land use policies and decisions;

7. Countries and international organizations to further develop methodologies and mechanisms for the valuation of forest goods and services and for facilitating the integration of non-traded forest benefits into markets and public decision-making processes, giving consideration to the equitable distribution of costs and benefits; as well as methodologies and mechanisms for including changes in forest stocks in national accounting systems;

8. Countries and international, regional and national research organizations to identify and undertake priority research activities, in response to the needs of society, that build upon existing scientific and traditional knowledge, emphasizing the need for applied research, and to widely disseminate results to all interested parties in a timely fashion;

9. Countries to develop and apply national level criteria and indicators for sustainable forest management to assess the state of their forests and develop national forest inventory and monitoring systems, which take into account these criteria and indicators, as well as to provide data to improve the FAO global forest resources assessment programme beyond the year 2000;
10. Countries, international organizations, major groups, the private sector and other interested parties to promote greater public awareness of the vital role of forests to society, the problems facing the world’s forests and the urgent need to work together to implement practical solutions to improve the management of forests;

11. Countries, international organizations and non-governmental organizations to foster community forestry and agroforestry programmes and enhance extension services to forest owners and users in order to better address the needs of individuals and local communities relying on forests and promote investments in sustainable forest management;

12. Countries and international organizations to recognize that, in many regions of the world, fast-growing tree plantations can contribute to sustainable management of forests by meeting subsistence needs and can complement, and/or reduce the pressure on, natural forests through increased supply of forest goods and services;

13. Countries to develop, implement and review policies, plans and management practices aimed at minimizing the destructive nature and extent of wildfires on forest lands;

14. Countries to prepare and implement national forest programmes as a means to establish national priorities and identify actions needed to manage forests sustainably in a participatory and transparent manner, securing ownership and traditional rights;

15. Countries and the international donor community to give increased attention to the rehabilitation of degraded forest land and to addressing desertification problems through elaboration and implementation of national plans for combating desertification, with particular attention to the problem of moving sands and arid and semi-arid lands, to better meet the subsistence needs of people, particularly those relying on forests for food, fuelwood and fodder;

16. Countries, international organizations, academic institutions and forestry professionals to raise awareness at all levels of the importance of biological diversity, including conserving, enhancing and sustainably utilizing forest related genetic resources, which provide significant benefits to present and future generations;

17. Forest industries to adopt and implement voluntary codes of conduct to contribute to sustainable forest management through their domestic and international operations, including through management practices, technology transfer, education and investment;

Extend our warm appreciation to the Government of the Republic of Turkey for hosting, with the support of FAO, the XI World Forestry Congress and request that they disseminate widely the conclusions and recommendations of the Congress, including this Declaration, to governments, international organizations and the range of interested parties.

Antalya, Turkey
22 October 1997
Address by Ersin Taranoglu

Turkish Minister of Forestry, President of the Eleventh World Forestry Congress

His Excellency, the President of Turkey, The Honourable Prime Minister of Turkey, Esteemed Director-General of the FAO, Esteemed Ministers, Distinguished Ladies, Distinguished Guests, Distinguished Members of the Press,

I am very glad to be here with you here in Antalya, on the eve of the final World Forestry Congress of the century, which the 108th FAO Council awarded to my country after the Tenth World Forestry Congress in Paris. I would like to welcome and greet you all with respect.

I would like to thank you for having elected me President of the Congress. On behalf of 18 of my friends who have been elected vice-presidents, I also thank you for your trust in us and your kind regard.

When your technical duties are not totally absorbing you, I invite all of you to be our guests. I am sure you will experience the best examples of Turkish hospitality during your stay.

In addition to the daily tours around Antalya, you will have a chance to see the historical and cultural riches of our country in the tours to Topkapi Palace, Haghia Sophia Sultanahmet in Istanbul, Sumela in Trabzon, Efes in Izmir, Pamukkale in Denizli and Cappadocia in Nevşehir.

I believe that the Eleventh World Forestry Congress, taking place as it is after the Rio Summit which resulted in the Forestry Principles and Agenda 21, the Intergovernmental Panel on Forests, the Commission for Sustainable Development and the Special Session of the United Nations General Assembly; and the main theme of which is “Forestry for Sustainable Development: Towards the Twenty-first Century”, will be a milestone on the way to sustainable development.

Consistent with our viewpoint that sustainable development can only be achieved through public participation, this World Forestry Congress has special sessions on the Role of Women and Youth.

One of the greatest factors threatening sustainable forestry in the twenty-first century is the imbalance between population increase and forest product consumption, a pressure that can lead to forest destruction. In order to reduce this pressure, new policies that provide for the participation of both producing and consuming parties in sustainable forestry processes should be implemented. While doing so, approaches that take socio-economic, cultural and ecological structures into account should be employed. Such approaches should also show ways to mobilize the unused capacity within the economy.

Forest fires still seriously threaten sustainable forestry in many countries and particularly those in the Mediterranean basin. Owing to a better understanding of the functional values of forests, they have become important for all countries, and protecting them through regional and international cooperation that draws upon mutual solidarity has become a must.

Distinguished Guests,

The sustainability of forests, which contain the greater part of biodiversity, and the sustainability of agricultural and rural development cannot be studied separately. Considering this fact, in order to highlight the importance of World Food Day (October
16) there will be a tree-planting ceremony to establish the Eleventh World Forestry Congress Arboretum and Memorial Park. As this forest grows, it will become a symbol of forests as the indispensable common asset of the countries of the world.

In the Informal Meeting of Ministers I and my colleagues have attended today, we have had a very fruitful exchange of opinions on the main challenges to the implementation of sustainable forest management, solutions to them and the role of international organizations in improving sustainable forest management applications. We have also underlined the importance of global cooperation, and this is reflected in our press communiqué.

Esteemed Guests,

I firmly believe, with your arduous efforts and contributions, the Eleventh World Forestry Congress will yield very fruitful results for the next generations. I would like to end my speech by giving my best regards to you all.

Before I invite the Director-General of FAO, Mr Jacques Diouf, to deliver his speech, I would like to present him, on behalf of all member countries, this small memento for having provided us with the support and experience of FAO in all stages of the preparation, in order to ensure that the Congress be held properly. ♦

Address by Jacques Diouf
Director-General of the Food and Agriculture Organization of the United Nations

Mr President of the Republic of Turkey,
Mr Prime Minister,
Mr Chairman,
Ministers,
Mr Mayor,
Excellencies,
Distinguished Participants,
Ladies and Gentlemen,

It is indeed a pleasure for me to be with you here in Antalya today. It is not hard to understand why, in the first century BC, the Pergamum King Attalus who founded this city chose a name which means “heaven on earth”.

In the more than 2 000 years since then, the Turkish Government and its people have never forgotten the crucial role of forests in maintaining both the beauty and the productivity of their country’s natural resources.

Mr President,

Allow me to pay special homage to the evident love of this country for forests, both its own and those of all humankind. I would be remiss if I did not also add...
special thanks for your personal commitment to and involvement in the organization of this Congress and, particularly, the preparation of these extraordinary facilities.

Ladies and Gentlemen,

I extend my warmest greetings to you, the more than 4,000 participants at this Congress. It is a privilege to speak before you, who bring expertise, experience and devotion to the cause of the world’s forests.

This will be one of the last of these important gatherings in this century. It gives me great pleasure to note the Congress theme – ‘Forestry for Sustainable Development: Towards the Twenty-first Century’ – for it reflects the outward-looking perspective that must be adopted by the forestry community if we are to ensure that the world’s forests survive and, more important, deliver their full potential in overall socio-economic development.

Ladies and Gentlemen,

You, the stewards of the world’s forests, are gathered here to discuss and debate progress towards the achievement of sustainable forest management – and to help define and shape your work for the future. As you take up your complex yet essential task, I would challenge you to remember the more than 800 million people in the world today who still do not have access to adequate food and nutrition, and to consider how forests and forestry can contribute to the alleviation of this unacceptable and unnecessary suffering.

Just 11 months ago, 112 heads of state and government and other leaders from 186 countries gathered in another ancient city – Rome – for the World Food Summit. At the Summit, which FAO was privileged to host, a renewed high-level commitment was made to the eradication of hunger and to the achievement of lasting food security for all people.

The Summit participants adopted the Rome Declaration and a Plan of Action for achieving food security. These two documents set forth a seven-point plan stipulating concrete, practical actions. Throughout the documents, the important role of forests and forestry in achieving world food security emerges clearly.

There is an ancient Kashmiri saying which, loosely translated, reads “Food will last as long as forests do”. This is not to say that forests and foresters can single-handedly resolve the food security problem. But trees, forests and forestry do have a fundamental contribution to make towards the achievement of world food security. Although this audience may understand it well, I believe that the role of forestry in food security bears underlining, especially in the context of its contribution to sustainable development.

**THE ROLE OF FORESTRY IN FOOD SECURITY**

**Direct access**

First, trees and forests produce food directly. In some areas they are a primary source of food; almost everywhere they provide a regular supplement to the diet. Foods from the forest are consumed when cultivated supplies are in short supply, such as between harvest seasons, or during emergencies, such as famines and wars.

**Sustaining agricultural production**

Beyond the direct contribution of food, trees and forests play a critical role in ensuring sustained agricultural production, including animal husbandry and, in some cases, fisheries.

Trees and forests help maintain the soil and water resource base and the ecological balance, essential to food and agricultural production. They are incorporated into or shelter farming systems and their borders. They support livestock raising by providing fodder, especially during seasonal shortages in arid
and semi-arid areas. Under special circumstances, for example in coastal mangrove ecosystems, trees have a role in supporting fisheries, thus ensuring a major food source.

In this regard, it is curious and disturbing to note how agriculture and forestry have often been, and sometimes still are, viewed as being in opposition. This false dichotomy is perhaps based on the outdated view that forestry is concerned only with managing forests for wood production, and that agriculture only involves growing crops in open fields. Indeed, forestry and agriculture are often mutually beneficial and even interdependent.

On the other hand, it is an acknowledged fact that most deforestation is caused by logging and conversion of forest land to agricultural production. A reduction in the destruction of forests as a source of physical access to land can only be achieved by an increase in the sustainable and economically viable use of forest resources, intensified agricultural production on already cleared lands and a closer harmony between forestry and other forms of land use, particularly agriculture.

Forests and energy
Having food, though, is not enough. Many of the foods that form the staple diet are unpalatable or indigestible unless they are cooked. And in most of the developing world, boiling water is virtually the only method to render it safe for drinking. Wood is still by far the main source of household energy for some 40 percent of the world’s population. And for most of these people, the prospect of switching to fossil fuels is both unsustainable and economically out of reach.

Biological diversity
I would also note that forests are the most important terrestrial gene banks. Many of the foods we consume today, particularly basic staples such as rice, originated as wild crops in the forests. And forests continue to serve as a gene pool repository, for present and future food crops.

Economic access to food
Beyond their contribution to ensuring physical access to food supplies, forest-based activities also provide substantial employment and cash income. This is true both for large-scale industrial activities as well as for individual or community-based activities. FAO estimates the annual value of fuelwood and wood-based forest products to the global economy to be more than US$400 billion, or about 2 percent of the gross domestic product. If the value of non-wood forest products were to be added, this figure would be swelled considerably.

Thus, trees and forests play an unequivocal role in supporting food security. And if they are to continue to serve this and their many other functions, the trees and forests of the world must be managed, and managed sustainably.

The complexity of the issue of sustainable forest management is clearly evidenced by the intense and articulated agenda that you have before you. Let me highlight one topic of particular importance – that dealing with resource mobilization for sustainable forestry. Without sufficient investment in forestry, there simply is no way that the world’s forests and trees can make their just contribution to sustainable development. And despite the good words spoken at the Earth Summit, the paper you have before you on the topic of resource mobilization indicates that official development assistance to forestry today is only 27 percent of the amount suggested in UNCED’s Agenda 21.

WORLD FOOD DAY – “INVESTING IN FOOD SECURITY”

Ladies and Gentlemen,

World Food Day, marking the 52nd anniversary of the founding of FAO, will be celebrated on Thursday, 16 October. The theme of World Food Day this year –
“Investing in Food Security” – is linked directly to one of the seven commitments made by global leaders at the World Food Summit in November 1996. That commitment states:

We will promote optimal allocation and use of public and private investments to foster human resources, sustainable food, agricultural, fisheries and forestry systems and rural development, in high and low potential areas.

In an effort to raise awareness and to mobilize resources, on the occasion of this year’s World Food Day FAO has launched TeleFood – the first global television programme which, inter alia, appeals to the general public to donate funds for food security projects and activities. The potential role of forestry emerges clearly in the TeleFood campaign.

Ladies and Gentlemen,

This occasion represents an unusual opportunity in that I have the chance to address the experts and decision-makers of a relatively homogeneous community. With your indulgence, I would like to spend a few minutes on the work of FAO in helping countries to achieve sustainable forestry development.

THE ROLE OF FAO

Since its establishment in 1945, FAO has evolved into the world’s leading international agriculture and forestry organization. Today FAO has 174 Member Governments, a comprehensive regional structure, a physical presence in more than 100 countries, and an experienced cadre of specialists in agriculture, fisheries, forestry and related disciplines.

FAO is in a unique position with respect to the pursuit of sustainable development, particularly given the important need for cross-sectoral linkages.

The FAO Forestry Department is the largest and oldest international forestry unit of its kind, with a broad and comprehensive charter that addresses all forests. One message that rang loud and clear from the Earth Summit, and which was repeated at the World Food Summit, is that North and South must come together to address world problems, and this must be done in an interdisciplinary and cross-sectoral manner which recognizes that environmental protection and economic development are mutually dependent. In forestry, I think that no organization is better equipped than FAO to do this.

As in all aspects of its work, the primary roles of FAO in forestry are to serve as:

• a neutral policy forum;
• a source of information and advice; and
• a provider of technical assistance.

Each of these offers ample opportunity to advance sustainable forest management.

A neutral policy forum

Policy dialogue is a major role of FAO. Foremost among the means FAO places at the disposal of its member countries is the Committee on Forestry. Heads of forest services and other senior government officials meet at FAO headquarters every two years (along with representatives of other international and non-governmental organizations) to identify emerging policy and technical issues, to seek solutions and to advise on appropriate action. Six regional forestry commissions complement the work of the Committee on Forestry.

Another example of FAO’s work in facilitating policy dialogue and decision-making relates to national forestry programmes – efforts by countries to plan the sustainable development of the forestry sector and to coordinate implementation locally and with the support of the donor community.
A particularly good example of the work of FAO in support of dialogue at the international level is the role it plays in the organization of these World Forestry Congresses. Although the World Forestry Congresses pre-date FAO, the first having been held in 1926, since its creation FAO has always provided pivotal support to the host country.

**A source of information and advice**

Sound forestry decision-making requires accurate, up-to-date information and statistics, and FAO is a world leader in their collection, dissemination and analysis.

The *State of the World’s Forests* is FAO’s biennial policy-relevant summary of data and issues related to the status and trends of forest resources, production and trade and industrial development.

According to the *State of the World’s Forests 1997*, between 1990 and 1995 there was a net loss of 56.3 million ha of forests (natural forests plus plantations) worldwide, representing a decrease of 65.1 million ha in developing countries, partly offset by an increase of 8.8 million ha in developed countries. While the loss of natural forests in developing countries remains at a high level, there are signs that the rate of loss may be slowing. Natural forests in developing countries decreased by 13.7 million ha annually over the 1990-1995 period, compared with 15.5 million ha per year over the 1980-1990 period.

**Technical cooperation**

FAO places its technical expertise in forestry directly at the disposal of member countries through its Field Programme, supported by a combination of extrabudgetary resources. In 1996, the Forestry Field Programme reached an annual expenditure of US$60 million. A key feature of the Field Programme is its interrelationship with the normative work undertaken by FAO staff at headquarters and increasingly through our network of regional and subregional offices, thus ensuring two-way exchanges of expertise and experience.

Another important aspect of our work in technical cooperation involves assisting countries in mobilizing investment in forest development and in increasing investment performance.

Thus, by serving as a vibrant policy forum, a source of technical information and by assisting countries in capacity building through technical cooperation, FAO helps countries protect and develop forests while deriving sustainable economic benefits from them.

Although most of you are no doubt aware of the serious financial difficulties facing the UN system, including FAO, I want you to know that I am committed to maintaining in FAO the strongest and the most dynamic forestry programme that our member countries can afford.

**PARTNERSHIPS**

In stressing the commitment of FAO to sustainable forestry as an integral part of overall socio-economic development, I would not, however, wish to leave you with the impression that FAO can do everything. At FAO we recognize that the challenges which face forestry are more than any organization can single-handedly address in an adequate manner. We therefore deem it essential to seek partners proactively in all our work.

The surge in world interest in forestry in recent years has been paralleled by the interest and involvement of many international organizations in this sector, both within and outside the United Nations system. These organizations need to complement rather than compete with each other. Otherwise, we risk simply spreading already scarce resources even more thinly. It would be appropriate for this Congress to reaffirm the commitment of the forestry community to a partnership approach to the challenges of sustainable forestry development.
CONCLUSION

Mr Chairman,

I am convinced that the deliberations of this Congress, as its predecessors’, can be of major importance in shaping the future of world forestry, spurring policy commitments and practical initiatives that will allow forestry to make its maximum contribution to sustainable development.

I wish you success in your discussions and thank you for your attention. ♦

Address by Süleyman Demirel

President of Turkey

Mr Director-General, Distinguished Representatives, Ladies and Gentlemen,

It is a great pleasure for me to address the Eleventh World Forestry Congress. I welcome you all to Turkey, the global meeting point of civilizations, cultures and peoples. Today, the people of Antalya are proud and honoured to be hosting for the first time in this hall a conference of such importance and magnitude. They have erected this transparent pyramid as a display of their traditional sentiments of hospitality and friendship.

We are living in an era where we face problems and challenges of a global nature; environmental degradation, pollution, soil erosion, desertification and deforestation are among such challenges. Because of their very nature they cut across boundaries. It is not within the reach of any single country to overcome them. Only with vision and in solidarity can humanity meet these challenges: your presence here today demonstrates the growing awareness that global problems require global solutions. In this context, this Congress is a positive and timely endeavour and your participation is most valuable.

We have to prepare for the twenty-first century with a sense of responsibility for the welfare of humankind and the earth. Our aim should be to create new environments that are ecologically sound and economically sustainable. It is a challenge that, should we fail to meet it, could imperil the lives of future generations on this planet. Let us remember that the earth is the only blue planet in our solar system, and the only planet that has life on it. We are all stakeholders in the future of this planet. Therefore, the concept of sustainable development is directly related to the sustainability of life. It has a direct bearing on the increase in the world’s population. In
this century alone, the population has tripled in size, causing great strain on the resources provided by mother nature. Sustainability means that we should not demand more from her than she is able to offer.

Throughout the twentieth century humanity has made enormous progress. On the other side of the coin, unprecedented global wars and massive destruction of the world’s basic life-support systems are also the products of this century. Reductions in the ozone layer, on the one hand, and carbon dioxide and other greenhouse gases emitted to the atmosphere, on the other, are severely threatening humankind and other forms of life. Species of plant and animal life are becoming extinct at alarming rates. Losses of biological diversity and of forest cover are changing the fundamental balances and resource systems essential to human life and well-being.

Distinguished Guests,

In Turkey, forest lands constitute 26 percent of the country, which is about 20 million ha. Turkey is home to 584 woody species, 76 of which are endemic. Turkish forests and wetlands are also home to a great variety of species, some of which are considered among the endangered categories. Turkey is keen to resist the pressure on the biological integrity of its forest ecosystems and to preserve this rich diversity of its flora and fauna.

The institutions of the civil society are partners of the Turkish Government in creating a greener environment. When I made a call to the Turkish people for a greener Turkey, almost everybody responded favourably: the governmental agencies, actors of civil society and individuals have taken part in the general mobilization for afforestation. Here I would especially like to extend my gratitude to the parliament for adopting the law on “The Mobilization for National Forestation and Control of Soil Erosion” and to the Ministry of Forestry for its leading role in the implementation of this law. My thanks also go, among others, to the members of the TEMA and ÇEKÜL foundations for their relentless struggle against soil erosion. They are all aware of the fact that preserving forests is tantamount to protecting the motherland. This, in turn, is nothing but saving the world for the future generations.

Distinguished Guests,

Continued population growth, coupled with agricultural expansion, urbanization and higher rates of global economic development, is a major trend that has had an adverse effect on forests. FAO has estimated that an additional 90 million ha of land may be brought into agriculture in the developing countries by 2010.

Increasing population and economic growth stimulate demand for industrial forest products, the impact of rapid infrastructure development and urbanization on land use, land cover and environment, which is evident in many areas of the world, calls for the development of urban forestry programmes.

Environmental awareness and public pressure have drawn attention to the future of the world’s forests. The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992, fostered commitment to international activity focused on the world’s forests. The Commission on Sustainable Development (CSD), which was created to follow the implementation of the UNCED agreements, established the Intergovernmental Panel on Forests (IPF). Chapter 11 of Agenda 21 and the statement referred to as the “Forest Principles” are other major contributions made by the Rio Summit to an international consensus on sustainable forestry. These initiatives
represent an unprecedented level of international focus on forestry.

The World Food Summit of 1996 marks another milestone in this direction. It called on governments, all actors of civil society and international institutions to establish legal and other mechanisms that would promote conservation and sustainable use of natural resources such as land, water and forests. This summit demonstrated once again the unbreakable bonds between sustainable development and food security: indeed, the real human security is the security of basic needs: food, shelter, a sound environment.

This Congress itself is indeed part of these efforts to pursue the formulation of scientifically sound criteria and guidelines for the management, conservation and sustainable development of all types of forest. The challenge is to meet the growing demand for forest products while safeguarding the ability of forests to conserve biological diversity, mitigate global climate change, protect against desertification and protect soil and water resources.

Distinguished Guests,

I believe that this Congress will be a great success and will provide a unique forum for the politicians, bureaucrats, experts, academicians, representatives of NGOs and other participants who have come from all around the world to share their experience, expertise and innovations concerning the sustainable management of the world’s forests.

Let us join our forces in promoting international solidarity for a greener world. I would like to indicate two areas for our priority attention: combating and preventing forest fires and mobilizing resources for reforestation.

Forest fires are an especially acute problem in the Mediterranean basin. I call on all the countries of the world to share their experience in this field.

Second, we should emphasize plantations of fast-growing trees in reforestation efforts – biotechnology provides new opportunities which should be seized in an effective manner.

Before I open the Congress, I would like to express my deep appreciation for the efforts by the members of the Organizing Committee and the Turkish institutions involved to make it a memorable one, as well as for the invaluable support and cooperation of the Food and Agriculture Organization of the United Nations. Their efforts are the guarantee of the eventual success of the Congress.

I invite all countries and peoples of the world to renew their pledge to global partnership and to develop policies that meet the needs of the present without compromising the green dreams of future generations.

Turkish tradition has been immortalized in the following verses of the (Turkish) poet Mehmet Emin Yurdakul:

“O friend, don’t cut this tree for, cursed is the hand that hacks a tree let the sweet birds jump from its branches don’t cut it, let the weary peasant rest in its shadow don’t cut it, let the lovely village enjoy its presence don’t cut it, let this beloved country live in joy”

Thank you.
Values, beliefs and management of public forests in the Western world at the close of the twentieth century

J.J. Kennedy, M.P. Dombeck and N.E. Koch

A broad, introspective examination of existing and emerging core beliefs that define and direct public forest management.

Forest managers and other science-based professionals began this century largely as heroic public guardians in emerging European and United States industrial societies (Weber, 1947; Veblen, 1963). Foresters in the United States and their charismatic leader, Gifford Pinchot, patterned themselves after European colleagues. They were an important part of the United States’ progressive movement, aspiring to be scientifically powerful and pure, uncorrupted by self-interest or politics and trustworthy to pursue the public good in forests – as were their progressive colleagues in hospitals, schools and laboratories (Hays, 1959; Frome, 1962).

Midway through the twentieth century, European and United States foresters were confident and rightfully proud of their contribution to their nation’s economies and ecosystems (Greeley, 1951; Hasel, 1971; Steen, 1976; FAO, 1989). They provided the world much needed sustained yield conservation values, beliefs and management systems to supply dependable flows of wood and other resources for growing urban, industrial nations (Hays, 1959; Hummel, 1984; Wiersum, 1995).

As this century ends, the Western world is engaged again in a major socio-economic transition to an urban, post-industrial, global economy and society (Drucker, 1986; Reich, 1991). Unlike the beginning of the century, there is considerable public scepticism and re-evaluation of the lofty, idealistic position of forestry, legal or medical professionals – especially in the United States (Rolston and Coufal, 1991; Nelson, 1995; Hess, 1996). Many long-standing public forest and natural resources management policies and practices are being questioned. Those who care for and manage forest ecosystems (especially those that are publicly owned) are being challenged to adapt their professional values and management concepts to the increasing diversity, complexity and interdependence of ecological and human systems, to continue to be as socio-politically and environmentally effective as they were in the past (Knight and Bates, 1995).

This article offers a broad, introspective examination of existing and emerging core beliefs that define and direct public forest management (and that of many other natural resources). Although focusing on public forest management and foresters, many of the observations also apply to public and private wildlife, watershed, range, recreation or general environmental management and the associated professionals (Kennedy, Fox and Osen, 1995).

PERCEPTION AND PARADIGM SHIFT IN TRADITIONAL FOREST AND NATURAL RESOURCE MANAGEMENT BELIEFS

The evolving protector and use provider roles of public forest professionals

One reason why foresters and other natural resource professionals are so vulnerable to social criticism is a function of their often conflicting roles in multiple-use public land management. For they are both long-term resource providers and providers of goods and services for citizens living today (Koch and Kennedy, 1991; Hytoenen, 1995). The Figure illustrates the general evolution of European and United States public forest managers’ roles and mediating stewardship concepts (e.g. sustained yield or ecosystem-based stewardship) that attempt to link and balance these often conflicting protector-provider responsibilities.

The protector role (Figure, top row) begins with a forest conservation focus on long-term, maximum site production (i.e. maximum flows of goods and...
services), within sustained yield limits. This is maturing today to incorporate a more inclusive management focus on healthy, sustainable forest ecosystems themselves as well as the multiple-use output endowments, i.e. provider role (Figure, bottom row), they can bestow on current generations.

Sustained yield was the initial stewardship concept of early Western conservation movements (Wiersum, 1995). It constrained and balanced current societal forest use against maintenance of long-term resource productivity for future generations (Figure, middle row). In 1804 Hartig (head of the Prussian Forest Administration, Berlin) directed his foresters to manage forests to: “...utilize them to the greatest possible extent, but still in a way that future generations will have at least as much benefit as the living generation” (Schmutzenhofer, 1992, p. 3). “New forestry” (Kessler et al., 1992) and sustainable ecosystem-based stewardship in the United States (Bureau of Land Management, 1994b; USDA, 1994; Council for Environmental Quality, 1995), and the similar integrated multiple-use management (e.g. Saastamoinen et al., 1984; Hytoenen, 1995) and sustainable forest ecosystem management in Europe (e.g. Koch, 1991; UN, 1993; Government of Denmark, 1994) are evolving beyond this central sustained yield, output focus. Ensuring healthy and sustainable forest ecosystem processes is now viewed as a central management focus, rather than a constraint to a maximized stream of sustained yield outputs (Kennedy and Quigley, 1993).

Western world forests have usually been viewed as management objects of goods/service outputs for their owners/users – in Europe they were initially the property of nobles and, later, of a broader segment of society (Fritzboeger and Soendergaard, 1995; Stridsberg, 1984). Many people today are beginning to view forest ecosystems as the “subject” on which humans depend for utilitarian goods and services, social and spiritual self-identity (such as loggers, hikers, birdwatchers, hunters or foresters) and other social values (Koch and Kennedy, 1991).
through diverse and changing forest and human cultural relationships (Harrison, 1992; Fernand, 1995). Yet sustainable forest ecosystem management is far from an accepted, operable concept (e.g. Dixon and Fallon, 1989; President’s Council on Sustainable Development, 1996). We feel that the need for economic development and ecosystem management theory and practice to evolve jointly in this direction in the twenty-first century is less open to debate (e.g. Shearman, 1990). The Western world must develop and refine these new forest relationships, meanings and management through thinking, learning from other cultures, public debate and on-site forest engagement. It is an evolving educational process and, hopefully, we have matured to the point where the forest can be the subject that teaches us, as well as being the object of our well-intended management and protection.

The role of the public land manager as a provider of goods and services has also evolved and matured beyond a focus on output quantity. Today there is more consideration of outcomes directly and indirectly generated by outputs and a greater focus on customer service (e.g. how output qualities and outcomes are perceived by and have an impact on people).

In the United States conservation movement of the 1950s, most public land customers were distant and infrequent visitors – especially in the western United States and Alaska. Public land managers helped provide water, logs, salmon, cattle and ducks for “customers” who were far away from the managers and their resource areas. Such customer distance, and often alienation, facilitated mechanistic production thinking and a resource management orientation as opposed to a customer service or social value orientation (Gluck, 1987; Koch and Kennedy, 1991; Kennedy and Thomas, 1995). Natural resource management today is much more of a “contact sport”, as a greater number and diversity of customers are directly involved in the use and management of public lands – they increasingly come to “our” forests and challenge our traditional values and management. It has been a long and difficult evolution for many public land managers from being isolated resource protectors to engaged customer facilitators and negotiators (Fairfax and Achterman, 1977; Magill, 1988).

We envisage future evolution in public land managers’ provider role as incorporating more consideration of outcomes and customer service concepts in a broad context of short- and long-term social values (Kennedy and Thomas, 1995). Rather than physical resource manipulators, public land managers are often social value brokers and conflict management facilitators – and will become more so in the future (Hytoenen, 1995; Kennedy, Fox and Olsen, 1995). This will require sustainable forestry and other natural resource management to expand beyond a biological, ecosystem focus and incorporate regional economic and socio-cultural systems that consider the human relationship aspects of forest functions and their diverse social values (Shearman, 1990; Brunson and Kennedy, 1995; Fernand, 1995). Rather than just ecosystem management, public land management must focus more broadly on sustainable systems management (including interrelated ecological, socio-cultural and economic systems) in a collaborative or partnership relationship. The following text and tables expand and elaborate on the evolution of these public land management roles and core beliefs.

**The transition from machine model to organic forest management thinking**

One reason why many Western natural resource professionals and agencies are experiencing difficulty in adapting their values and management to the twenty-first century is that they have been so successful in this one (Clarke and McCool, 1985; Nelson, 1995; FAO, 1988; FAO, 1989).

Specialized agencies and professionals have generally been successful in ensuring sustained yield flows of wood, water, recreation and wildlife goods and services from public lands. Agencies such as the United States Department of Agriculture (USDA) Forest Service grew in size, budget and socio-political support throughout the first 80 years of this century. It is not surprising that such a successful agency in the United States’ industrial era had developed a “machine model” perspective in thinking and in managing its forests (and their users) and its employees (Taylor, 1957; Schiff, 1966).

### TABLE 1. Comparison of machine and organic models

<table>
<thead>
<tr>
<th>MACHINE MODEL</th>
<th>ORGANIC MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First 75 years of twentieth century</strong></td>
<td><strong>Close of twentieth century</strong></td>
</tr>
<tr>
<td>Perspective: world composed of simple, independent systems</td>
<td>Perspective: world composed of complex, self-organizing, highly integrated systems</td>
</tr>
<tr>
<td>Aim: reduce systems complexity by isolating and separating subsystems</td>
<td>Aim: understand integrated, interrelated systems organization and processes</td>
</tr>
<tr>
<td>Linear, cause-effect systems organization and processes are the norm</td>
<td>Multifaceted and cumulative effect, cyclical and synergistic systems relationships are the norm</td>
</tr>
<tr>
<td>Use of deductive logic and simple efficiency optimization models appropriate</td>
<td>Use of inductive, integrative logic and complex, inclusive simulation models appropriate</td>
</tr>
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Unasylva 192, Vol. 49, 1998
Characteristics of machine model thinking

Machine model thinking approaches management by viewing the world in rather simple, segmented and linear terms as opposed to the emerging organic model perspective (Capra, 1983; Kennedy and Quigley, 1993):

Many foresters and other natural resource managers who were educated in the first 75 years of this century followed the machine model in their quest to become rational, respected adults and professionals. They were usually trained to “take control” of a complex and messy world by fragmenting it into separate, rational, manageable subsystems.

In agencies such as the USDA Forest Service, machine model thinking was manifested in many ways, including:

• a narrow forest ecosystems perception and focus (e.g. simple timber site productivity models and management);
• forest or fire management (e.g. intensively managed plantations, forest pest wars or the practice of guaranteeing “all wildfires out before 10 a.m.” (Schiff, 1962));
• modelling (e.g. a fascination with linear programming that reached its peak in the 1980s’ national forest FORPLAN models);
• dichotomous thinking (e.g. timber versus non-timber resources, economic versus non-economic values);
• agency organizational structures (e.g. line staff hierarchies or narrowly defined functional responsibilities);
• organizational behaviour (e.g. unquestioned loyalty to line officers, frequent transfers of Forest Service employees with little regard for family impacts (Kennedy and Thomas, 1992));
• relationship with the public (e.g. “educating” the uninformed public on proper, scientific national forest management; (Brunson, 1992));
• simple views of rural economies and the role of public forestry (e.g. a sustained flow of logs will provide community employment stability (Schallau, Maki and Beuter, 1969; Gomoll and Richardson, 1996); and
• narrowly focused research scientists and projects that were often not related to societal or management needs (National Research Council, 1990).

Forest (and other natural ecosystems) in Europe and the United States have often been conceived and managed like Henry Ford’s early car (Model T) production lines (McGee, 1910). Single factor, cause-effect relationships and solutions were generally pursued by increasingly specialized professionals. Complexity and diversity were commonly viewed as the enemy. By force of intellect and will, foresters usually tried to simplify deductively, compartmentalize and dominate nature (summarized in Table 2). With the best of intentions, foresters were often educated and role-modelled to be rational, objective and independent “omnipotent foresters” (Behan, 1966) and master machine model managers – but so were many mid-century engineers, physicians and other professionals.

For example, frequent mistrust and suspicion of forest ecosystem complexity and diversity supported a perspective of forests besieged by many hostile “entropy” forces of fire, insects, animals (deer or cattle) or even human use. Foresters felt called to protect forests from many of their internal ecosystem dynamics and external entropy forces. Given such simple mechanistic and combative ecosystem views, foresters often thought themselves capable of controlling the perceived chaos of wildfires, insects or disease (and even the increasing numbers and types of recreationists). The new technological and genetic improvements of the 1950s added

<table>
<thead>
<tr>
<th>TABLE 2. European and United States machine model views of forest and related ecosystems evolving into organic model perspectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MACHINE MODEL</strong></td>
</tr>
<tr>
<td>First 75 years of twentieth century</td>
</tr>
<tr>
<td>Forests (shrubland, wildlife or rivers) often viewed and managed as mechanistic, factory systems</td>
</tr>
<tr>
<td>Forests composed of discreet, identifiable parts with clear dimensions and boundaries</td>
</tr>
<tr>
<td>Primary focus on forest structure, and then on forest function or process</td>
</tr>
<tr>
<td>Understanding of component forest parts equivalent to understanding of the entire system</td>
</tr>
<tr>
<td>Mistrust and suspicion of nature’s complexity, diversity and adaptability</td>
</tr>
<tr>
<td>A host of hostile and chaotic entropy forces lurk in and outside forests (e.g. fire, insects, recreationists, uneeducated public, predators)</td>
</tr>
<tr>
<td>Foresters can fully understand and dominate/control forests (as well as wildlife, wildfire or user groups)</td>
</tr>
</tbody>
</table>
to this illusion of control. The forest (and the larger world) seemed predictable, manageable and in need of a firm hand. Public foresters at mid-century were also largely permitted both to set forest goals and choose the management options (means) – managing public forests for the European or United States public. Given mid-century social values, they generally managed these forests well and earned public respect (Frome, 1962; Clarke and McCool, 1985). More complex, diverse and interrelated organic models are necessary to understand and adapt to today’s global environmental, economic and socio-political world. This is not to say that appropriate use cannot be made of focused, compartmentalized, machine model thinking and management. However, this segmented thinking and management must be made relevant in the context of a more inclusive organic model that integrates specific forest,

### TABLE 3. European and United States machine model views of forest management and managers evolving into organic model perspectives

<table>
<thead>
<tr>
<th>Common management perspective</th>
<th>MACHINE MODEL</th>
<th>ORGANIC MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guiding norm: sustained yield wood, game or forage maximization (output-focused) and economic efficiency (Wiersum, 1995)</td>
<td>Sustainable, healthy forest systems (process-focused) for diverse, changing market and non-market social values (Dixon and Fallon, 1989)</td>
<td></td>
</tr>
<tr>
<td>Intensively managed conifer plantations managed for control and efficiency</td>
<td>Diverse, multifaceted and multivalued forests (including plantations), watersheds and ecoregions managed for diverse, changing social values</td>
<td></td>
</tr>
<tr>
<td>Forests must heroically protect forests from hostile, entropy forces (e.g., fire, insects, vegetative competition, politics or recreational users), both within and outside the forest</td>
<td>Foresters and other forest managers can help forest ecosystems be healthy and robust enough to adapt effectively to many uses and forces</td>
<td></td>
</tr>
<tr>
<td>Forests are objects to use, control and manage for goods/services production for humans</td>
<td>Healthy, enduring forest ecosystems as “subjects” of value and respect in utilitarian, symbolic, identity and other relationships with humans and their cultures</td>
<td></td>
</tr>
<tr>
<td>Fascination with new industrial-age technology (e.g., machines, chemicals, linear programming, genetics)</td>
<td>Rethinking the balance of technology in management innovation, efficiency and resource use</td>
<td></td>
</tr>
<tr>
<td>Management era: primarily one-way, paternal flow of control from foresters to forest and other “outside” forces (including users)</td>
<td>Facilitation era: foresters in partnership with forests, diverse and interdisciplinary colleagues and public in collaborative socio-economic, ecological and other systems management</td>
<td></td>
</tr>
<tr>
<td>World is predictable: be smart, rational, plan, model and exert control</td>
<td>World is unpredictable: be open, aware, widely connected and adaptable</td>
<td></td>
</tr>
<tr>
<td>Economic growth/development model: develop capital, increase resource utilization, produce more (Rasker, 1994)</td>
<td>Evolution towards sustainability and community quality (quality of life) perspectives (Hyman, 1994)</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Respected forester role models</th>
<th>MACHINE MODEL</th>
<th>ORGANIC MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Era of tough, independent, great men, omnipotent foresters (Behan, 1966) and other professional heroes (Hess, 1996)</td>
<td>Era of interdisciplinary teams, power sharing and forester diversity to reflect national diversity</td>
<td></td>
</tr>
<tr>
<td>Patrotic management: caring, knowing, benign forest expert who is “in charge”</td>
<td>Partnership management: foresters facilitating a more open democratic process of public involvement, customer service and broad, diverse partnerships</td>
<td></td>
</tr>
<tr>
<td>Foresters manage forests for the people</td>
<td>Manage forest ecosystems in partnership with the forest and with the people</td>
<td></td>
</tr>
<tr>
<td>Objective professional, educated in hard sciences and, perhaps, economics</td>
<td>Professional educated in traditional hard sciences balanced and strengthened with philosophy, social science or communications skills</td>
<td></td>
</tr>
<tr>
<td>Tendency to specialize in separate forest or ecological subsystems, often in different bureaucracies</td>
<td>Specialization must be linked, validated and operationalized in larger ecological, political and socio-economic systems</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time perspective</th>
<th>MACHINE MODEL</th>
<th>ORGANIC MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targets: fiscal year, project horizons or stand rotation</td>
<td>Targets include broader, long-term view of desired future conditions</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Space perspective</th>
<th>MACHINE MODEL</th>
<th>ORGANIC MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on the forest stand</td>
<td>Expand to ecosystem, landscape and ecoregional spatial dimensions</td>
<td></td>
</tr>
<tr>
<td>Local and regional focus</td>
<td>Regional-national-global view</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 4. Evolving European and United States forest (and other natural resource) agency assumptions, values, structures and behaviour

<table>
<thead>
<tr>
<th>Basic agency assumptions, values and beliefs</th>
<th>MACHINE MODEL</th>
<th>ORGANIC MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First 75 years of twentieth century</strong></td>
<td></td>
<td>Close of twentieth century</td>
</tr>
<tr>
<td>Anti-entropy imperative: design, control and manage for disruptive, chaotic forces within and outside public forest resource agencies</td>
<td>Forest conservation era: fear of vulnerability often produced an 'us against almost everything' combative attitude towards legitimate human nature and natural system complexities and dynamics</td>
<td>Collaborative conservation era: respect, cooperate with and adapt to many potentially disruptive external forces (e.g. fire, insects, users or local politics) and internal forces (e.g. professional gender-ethnic diversity, reduced budgets and child care needs)</td>
</tr>
<tr>
<td>Forest conservation era: fear of vulnerability often produced an 'us against almost everything' combative attitude towards legitimate human nature and natural system complexities and dynamics</td>
<td>Exaggerated faith in science and scientists to illuminate public forestry's path and reveal the answers in the journey towards set goals</td>
<td>Science and scientists are but one set of values and skills necessary to plot agency vision or to identify, appraise, pursue and monitor planning and management options</td>
</tr>
<tr>
<td>With adequate expertise and technology, much of the forest and the world is predictable: be smart, rational, model, plan and exert control</td>
<td>Traditional conservation goals: focus on forest outputs, economic development and commodity clients (e.g. loggers)</td>
<td>Nature and the modern world are relatively unpredictable: be open, aware, accepting and adaptable</td>
</tr>
<tr>
<td>Traditional conservation goals: focus on forest outputs, economic development and commodity clients (e.g. loggers)</td>
<td>Agency espouses conservation values but rewards bureaucratic loyalty, product productivity and organizational maintenance behaviour (Kennedy et al., 1992)</td>
<td>Broader, more inclusive vision and goals</td>
</tr>
<tr>
<td>Agency espouses conservation values but rewards bureaucratic loyalty, product productivity and organizational maintenance behaviour (Kennedy et al., 1992)</td>
<td></td>
<td>Recognition of and efforts to reward pursuit of agency core values (Farnham and Mohai, 1995)</td>
</tr>
<tr>
<td><strong>Organizational design and structure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigid line staff organizational design (Twight, 1985) and scientific management (Schiff, 1966)</td>
<td>Stewardship and facilitation era: diverse, interdisciplinary colleagues and the public involved in collaborative dialogue and in sustainable planning and management (Shearman, 1990)</td>
<td>Organizational design and line staff rigidity becoming more flexible: sharing power with diverse team colleagues and partners (interagency and public)</td>
</tr>
<tr>
<td>Inform and educate era: primarily one-way, patriarchal flow of control from line managers to the resources, employees and the public</td>
<td>Only foresters should be involved in forest management</td>
<td>Forest managers are a diverse mix of wildlife biologists, economists, soil scientists, ecologists, landscape architects, foresters and others</td>
</tr>
<tr>
<td>Only foresters should be involved in forest management</td>
<td>Increasing forest resource specialization and often specialist isolation and alienation (e.g. Kennedy, 1987)</td>
<td>Recognition of broad environmental, diverse social science and people skills, and integration of specialists into teams</td>
</tr>
<tr>
<td>Increasing forest resource specialization and often specialist isolation and alienation (e.g. Kennedy, 1987)</td>
<td>Top-down production goals and organizational accountability</td>
<td>More bottom-up, community-level autonomy in planning and management</td>
</tr>
<tr>
<td>Top-down production goals and organizational accountability</td>
<td>Centralized, technical, linear programming models driving priorities and planning</td>
<td>Community-level, participation, consensus and conflict resolution in planning and advisory teams</td>
</tr>
<tr>
<td>Centralized, technical, linear programming models driving priorities and planning</td>
<td>Professional mystic potency: managing “for the good of the forest resource” (Duerr and Duerr, 1975). Foresters “know good when they see it”</td>
<td>Social value broker and facilitator: managing for short- and long-term social values (Kennedy and Thomas, 1995) of sustainable forest ecological, socio-cultural and economic systems</td>
</tr>
<tr>
<td>Organizational processes and behaviour</td>
<td>Patronistic management: caring, knowing, benign forester (or wildlife biologist, park ranger or other expert) who manages public lands for the people</td>
<td>Partnership management: managers facilitating a more open, democratic process of public involvement, customer service and broad, diverse partnerships</td>
</tr>
<tr>
<td>Professional mystic potency: managing “for the good of the forest resource” (Duerr and Duerr, 1975). Foresters “know good when they see it”</td>
<td>Implementation of increasingly complex laws and bureaucratic procedures</td>
<td>Need to simplify, humanize and facilitate regulations and regulators</td>
</tr>
</tbody>
</table>
wildlife or recreational management into a larger, long-term ecological, socio-economic and political context. The development and adoption of such organic model thinking and referencing does not come without challenges, threats and uncertainty – particularly given the background of many of today’s forestry decision-makers (Magill, 1988; Kennedy, Fox and Olsen, 1995). Yet to refuse this invitation to change is not an option for most agency professionals who are far from retirement.

In the 1990s, the dynamics of complex, interrelated environmental issues (e.g. Pacific salmon management in forest watersheds, European forest dieback, global warming) and the development of new integrative disciplines and concepts (e.g. landscape ecology [Botkin, 1990; UN, 1987]) have helped expand and soften the traditional boundaries of forestry, natural resource and environmental management.

Table 2 condenses and compares machine model and organic model views of forest ecosystems. Table 3 applies the implications of these beliefs to forest management and the roles of public forest managers. These two tables are not intended to represent polar dichotomies but rather to depict part of a public forest management continuum. They represent forest managers’ growing recognition of and increasing confidence in their ability to honour and embrace more complex, diverse ecological and interrelated socio-economic or political systems.

CHANGING ROLES AND RELATIONSHIPS OF PUBLIC FOREST RESOURCE MANAGEMENT, AGENCIES AND FORESTERS

Most European public forest services originated as part of the royal army that protected the nobility’s hunting and land rights (Fritzboeger and Soendergaard,
The USDA Forest Service was heavily influenced by the Prussian Forest Service and incorporated many of its values and methods of organization and operation (Twight, 1983; 1985). It was the first major United States conservation agency and served as a general organizational model for the later design of the National Park Service or United States Fish and Wildlife Service (Clarke and McCool, 1985).

United States forest and natural resource management agencies in first two-thirds of this century generally focused on laws and regulations, technology transfer, use control, infrastructure development, strategic planning or increased technological expertise to manage external forest entropy forces. Patriarchal line staff hierarchies, tight job classifications and promotion eligibility, centralized authority or rigid budget accountability were devices to combat internal organizational entropy (Schiff, 1966). Such a heritage of values and beliefs often created very focused, cohesive and, by many traditional measures, successful agency cultures for the 1950s and 1960s (see Table 4). The USDA Forest Service, for example, drafted most of its own guiding legislation until the advent of the Wilderness Act (1964) and the National Environmental Policy Act (1969). In this respect, according to other standard measures of organizational achievement, be it public respect (Frumkin, 1962), workforce loyalty and cohesion (Kauffman, 1960; Kennedy and Thomas, 1992), political influence (Gutnick, 1951; Culhane, 1981; Clarke and McCool, 1985) and organizational effectiveness (Gold, 1982), the Forest Service was a very successful bureaucracy. So too were other European and United States forest resource agencies, such as the Bureau of Land Management, the United Kingdom Forestry Commission and the Swedish and Danish Forest Services at the end of the Western industrial era (about 1970).

Yet the dark side of such 1950s’ machine model bureaucratic effectiveness would be its great difficulty in acknowledging and adapting to many socio-political changes soon to occur in an urban, post-industrial socio-economic transition (Reich, 1962; Hultman, 1984; Brunson and Kennedy, 1995). In the process of battling hostile internal and external entropy forces, natural resource managers sometimes alienated themselves from the land, their colleagues and users or other segments of society. Today, many of these traditional agency assumptions, values and core beliefs are being reconsidered.

Change in European and United States natural resource agencies is evident today in new agency visions (e.g. Bureau of Land Management, 1994a; Government of Denmark, 1994; USDA, 1994), the reduced functionalism of agency structure, budget systems and promotion eligibility; the greater number of members of public employees in forest planning, management and monitoring; and assessments of the environmental and social values of multistate or multinational forest ecosystems (e.g. UN, 1987; 1993).

Whealely (1992), in his pioneering book, is a good foundation for envisaging new paths for public natural resource management and agency cultures in the next century. Senge (1990) and Kofman and Senge (1995) offer an expanded, pragmatic application of this new, organic model or system-oriented organizational thinking. Table 4 applies some of this thinking to natural resource professionals and agencies.

### The foresters

In 1950 almost all public forest managers were foresters (Table 4, final section). In the United States and Europe today there are many types of professionals involved in forest research, planning, management and monitoring (e.g. soil scientists, ecologists, landscape architects, sociologists or recreation planners). Although professional workforces that are diverse in gender and ethnic background tend to be characterized by healthy dynamics (Kennedy, 1987; 1988; Thomas and Mohai, 1995), this can also lead to the risk of organization or agency dysfunction. In United States multiple-use agencies, timber, mineral, range and engineering professionals often battle with wildlife, recreational or environmental colleagues. Such dysfunctional behaviour can counterbalance the benefits of racial, professional or gender diversification (Kennedy, 1991) and requires more forest ecosystem and people management competence than ever before. Table 4 (first section) also draws attention to an exaggerated faith in scientists and scientifically trained managers to devise both public forest goals and efficient management means for achieving them. Organizations, including the forest services of the United States, Sweden and the United Kingdom, often behaved like scientific and technological aristocracies, with well-meaning, data-rich, computer-enhanced plans to transform diverse forest (and other) ecosystems into intensively managed, accessible, wood-productive and multiple-use forest systems. Such machine model public forest plans might have been appropriate for Western social values of the 1950s and 1960s but they were not in the 1970s and 1980s, and contributed to major clashes between industrial and post-industrial social values.

Today foresters and forest ecosystem managers are adopting more of a facilitator and negotiator role in assisting citizens of a democracy in developing long-term public forest goals and broad parameters for management options (e.g. clear design and harvesting standards).
within which professionals make short-term operational decisions (e.g. the participation of user councils, recently established in all Danish national and state forest districts). From the traditional “inform and educate” mode of forestry whereby professionals managed forests for the public, professionals are now setting goals, managing and monitoring together with the public with a focus on ecosystem values and the concerns of various interest groups (Table 4, sections 2-3). Ecosystem managers are evolving from professional aristocrats to public servants (Magill, 1988), not forgetting that the majority of public forest stockholders whom we should all be serving are yet to be born.

CLOSING COMMENT

To succeed in the twenty-first century, forest ecosystem professionals and public agencies probably will have to do more than reinvent themselves in new shapes and customer orientations. It will require a deeper change of heart and broader, more integrated systems-oriented thinking. Kofman and Senge (1995) have found that, for organizations such as Ford or IBM to change, they must reach deep inside themselves and far back into their Western cultural heritage to create fundamentally new norms and forms of organizational thinking, meaning and behaviour. These authors believe that new, organic model thinking and behaviour are needed to heal organizational dys-function in: i) fragmented thinking and a problem-solving focus; ii) glorification of competition in work and play; and iii) reactionary and heroic manager response habits.

Sustainable ecosystem stewardship (or management) is a promising, organic model orientation towards public lands and waters that is being pursued in the United States and Europe under different names and forms. We believe this is a logical evolution and a maturation of traditional multiple-use, sustained yield conservation values and concepts (Wiersum, 1995). But sustainable ecosystem management should be considered a long-term evolutionary path (not a fixed, defined target). This inclusive, long-term, integrated system thinking of ecosystem-based stewardship is also compatible with and on a parallel path to Senge’s (1990) “learning organizations”.

The paradigm shifts that we, Senge (1990) and others suggest represent a powerful, fundamental change in organizational thinking and behavior. Similar to the quantum physics paradigm shift in the Newtonian scientific order (Capra, 1983), these changes are so profound that they will probably require a generation or two of evolution to become the dominant paradigm. As in ecosystem-based stewardship, the transition to organic model agency cultures will require faith, perseverance and adaptability as forest and natural resource agencies continue to shift their orientation from:

- Protective conservation to ... collaborative conservation;
- Patronistic bureaucracies to ... partnership organizations;
- Patriarchal, line staff tiers to ... open, adaptive, interdisciplinary teams;
- Linear-thinking specialists to ... synergistic integrators;
- Output-oriented managers to ... social value managers and stewards;
- Technical functionalists to ... ecosystem-based management facilitators.

Although we believe socio-economic and political change (Bennis, 1966; UN, 1987; 1993; Knight and Bates, 1995) will continue to drive public forest conservation values and beliefs towards organic model thinking and application (such as ecosystem-based stewardship), there are still powerful actors resisting the process, both in and outside natural resource professions and public agencies. We must willingly and openly test and adapt these emerging organic-model beliefs with dissenting voices and groups. Yet we see no future in the twenty-first century for closed (versus open), narrow (versus systematic and inclusive), short- (versus long-) term, or machine (versus organic) model thinking and behaviour in public natural resource organizations, regardless of how comfortable and secure old ways of thinking appear to be. 

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Privatization of forest sector research in Europe

E. Hellström, M. Palo and B. Solberg

The need to reduce public expenditures has brought about the question of privatization of research in many countries. Research can be privatized in at least three principal ways: first, the funding structure of a research organization may be privatized by increasing the share of (private) contract research. This is a strategy often adopted in order to increase the efficiency of public research organizations. Second, the ownership structure of a research organization may be privatized. The third form of privatization of research is the increase of private involvement in decision-making in science policy and in the government of research organizations.

Among the most relevant questions regarding privatization efforts in forestry research are: How does the private sector react to cuts in public research funding? Is there reason to expect private funding to compensate for reduced public funding? When research is privatized, to what degree do research priorities shift towards the interests of the private bodies involved in decision-making and capable of funding forestry research? How do different forms of privatization affect research activities?

The purpose of this article is to address some of these questions by:

- reviewing theories related to investment and public/private involvement in forest sector research;
- testing the theoretical criteria on public/private involvement in forest sector research with empirical findings; and assessing the applicability of privatization policies in forest sector research.

The theoretical framework and the empirical findings presented in this article are largely based on two research projects conducted at the European Forest Institute in 1994. In the first (Hellström and Palo, 1994; 1995a; 1995b; Hellström and Palo in FAO, 1995), the roles of public and private forest sector research in Europe were charted. In the second (Hellström, 1995), national case studies on the effects of changing funding patterns and policies on research activities were conducted in Finland and Norway as an initiative for further comparative studies in Europe.

THEORETICAL FRAMEWORK
Increased innovation as motivation for privatization

Privatization of research is often motivated by a scarcity of public funds available for research and the need to increase the productivity of research through improved interaction between the producers and the users of research results.

The basis for both arguments lies in an attempt to create innovation. This may take the form of novel products or services, novel methods, processes, systems or devices.

The model of a national innovation system (Fig. 1) can be used as a basis for understanding the arguments presented above. In the model, public R&D, education, training and extension are viewed jointly with similar private activities and with interactions between producers and consumers as a system leading to innovations and increased welfare. Two factors especially affect the number of innovations: learning by doing and the input that goes into the search for innovations.

In today’s situation, where there is a need for substantial savings in public expenditure, the privatization of research funding in order to maintain the present level of inputs in the search for innovations, or to even increase it, is seen as a potentially attractive alternative in many research fields. However, before this argument is accepted, the roles of public and private funding should be considered in the framework of economic theory and empirical findings.
Research funding and economic theory

Research as a financial investment.

Research and development projects are investment projects both from a private business point of view as well as from a national economic point of view. Their return has been studied less than conventional investments in goods and services, but over the past decades analytical literature around them has grown (see Dasgupta and Stiglitz, 1980b, for an early overview).

Criteria for the funding of forest sector research from the private business point of view can be examined in the regular framework of supply (S) and demand (D) functions (e.g. Hyde, 1986; Hyde, Newmann and Seldon, 1992). Research breakthroughs cause a decrease in production costs, or a downward shift in the supply function. As a result, greater quantities can be sold with lower prices.

In order for the private sector to have incentive to invest in R&D, the gains have to cover the research and development expenses, as well as giving a sufficient rate of return. The rate of return is dependent on how the supply and demand curves are transformed as a consequence of innovation. This is largely affected by the structure of the market and the conditions of competition.

Whether or not producers are willing to invest in research depends not only on profitability but also on the expected period of payoff of the investment. The time scale is a crucial aspect in research funding in two respects. First, in any research, a period of time is needed before the research investment can produce financial gains. The time aspect is also important in respect of how long it takes for the research breakthrough to deteriorate (Hyde, Newmann and Seldon, 1992).

The relation of a research investment to uncertainty and risk is twofold. First, the uncertainty of the future, which is a disincentive for other financial investment, may be the basic driving force behind research investment. In fact, one important motivation for research is to produce information that reduces the uncertainties related to other financial investments by estimating the risks involved. Second, risk is also a component of research investment per se.

Incentives for public research funding.

During the first part of this century, Schumpeter (1942) introduced clearly the idea that new products and new processes were the main source of dynamism in economic development. The Organisation for Economic Co-operation and Development (OECD), along with other international organizations and a number of national governments, adopted the increase of public R&D as an explicit strategy in the promotion of economic growth. This paradigm was particularly strong during the 1960s and 1970s.

Public research can increase competition by improving the knowledge base of buyers and sellers. It also breaks down barriers of entrance to the markets owing to lowered prices, increased output and increased productivity (Runge, 1983). In addition, because small- and medium-sized enterprises generally spend little on research, publicly funded research may be vital for the existence of many small businesses within forestry and forest industry.

Research results are also considered to be worth public support because of their strong positive external effects. In particular, the increase of environmental awareness in most countries is bound to be reflected in the funding of forestry research because the forest environment is clearly a public good.

FIGURE 1

A model of a national innovation system

Distributive impacts of public policy can be aimed at strengthening the economy by increased competition, with democracy and with ethic criteria. Distributive impacts of forestry research include the allocation of research benefits and costs among factors of production and between producers and consumers (Hyde, Newmann and Seldon, 1992). Public funding of forestry research is also justified on the grounds of sustainability, particularly in fields of research where research projects are of long duration. In a survey of 45 forestry research institutions in developed countries, Bengston and Gregersen (1986) found stability of funding from year to year to be nearly as important for the research performance of the organization as the actual level of funding.

Criteria: public versus private funding. Based on research in the United States (Hyde, Newmann and Seldon, 1992), it has been found that public investment in R&D is necessary:
- where research requires large initial investments, where a long lag in investment-productivity is expected and where these results are highly uncertain;
- where the industry demand is highly inelastic or the supply is elastic, and research benefits are rapidly and largely transferred to competitive higher-level producers and final consumers; and even
- where demand may be more elastic or supply more inelastic, many firms may share the positive aggregate production gains provided by research. Therefore, the individual firm’s gains are insufficient to cover the full research costs, even though each firm must invest these full costs independently in order to obtain any part of the industry’s total gain.

In the United States, the first case is more representative of industries other than forestry (e.g., space and defence); the second case holds for the sawmill and wood pulp industries; and the third case is true of both the sawmill industry and forestry, and it may even describe the softwood plywood industry. However, these United States experiences are only partially transferable to other developed countries with differing resource and market situations and differing policy incentives.

Three hypotheses of private research funding within the forest industries are formed for European conditions. First, the demand function of the sawmill industry is relatively inelastic while the supply function is relatively elastic. Research benefits are rapidly and largely transferred to competitive higher-level producers and to final consumers. Accordingly, little private research is expected to be conducted within this industry. Second, in the woodwork and furniture industries, producer gains may often be positive. However, in most countries, the small market shares of individual enterprises within these industries suggest that innovative enterprises may be unable to claim a large proportion of the gain from their innovations. In such cases the pooling of research expenditures and sharing of research results may be the rational way to invest in research and development. Third, in the pulp and paper industry, the demand function is more elastic than in the sawmill industry. Therefore, gains from research inputs can be expected to be larger. The pulp and paper industry is also more concentrated and capital-intensive than the diverse wood industries and can even provide for larger initial research investments. Thus, considerable private research investments can be expected to be found in the pulp and paper industries.

In addition to forest industry, there are some highly profitable research investments within traditional forestry as well. If property markets functioned perfectly, research gains from biological forestry research would increase the value of the property immediately and thus create immediate potential returns. Since this is not the case in most countries, private investors may be unwilling to invest in long-term research projects, despite the economic efficiency of the investment.

Nevertheless, perhaps the most important obstacle for privately funded traditional forestry research is the scattered pattern and small scale of forest holdings in many countries, which results in the same kind of problems as those in the case of sawmill and other wood industries presented above.

Yet, it is not probable that the existing patterns of funding of forestry research in all cases will follow the rationale presented above. Instead, many ideological, political, cultural, institutional and, in small countries, also personal factors may affect decisions on research funding. In addition to attitudes towards science in general, different political ideologies and forces may tend to privilege particular fields of research and development. Accordingly, the problem of research funding is dependent on theory and is a function of perceptions and power.

**EMPIRICAL FINDINGS**

**The European pattern**

The purpose of the European study (Hellström and Palo, 1994; 1995a; Hellström and Palo in FAO, 1995) was to formulate criteria for a rational division of private and public forestry research and to test these criteria with a survey of forestry research organizations in Europe. The material for the study was collected from international directories of forestry research organizations (FAO, 1986; 1993; Agricultural Research Centres, 1988) as...
well as forest and science policy-related literature. Additional information was collected through interviews of representatives of selected European countries. All together the material covers 29 European countries, 205 research organizations and a total of 7,879 researchers.

The concept of forest sector research comprised both traditional forestry research and forest products research. The structure of forestry research can vary according to the degree of basic and applied research as well as development work. In these aspects and others, the material available for the study determined to a great extent the scope of forestry research included in the study. For example, research in many forestry-related fields such as environmental aspects of forestry, wildlife, agroforestry, land use and forest products were, for practical reasons, included in the study only when it was conducted at research establishments with a permanent input in forest sector research.

The material contained three main deficiencies. First, R&D conducted within individual enterprises were also, owing to missing data, excluded from the study. Therefore, it is probable that private research and development efforts are underestimated in countries with significant forest industries.

Second, the study focuses on the sectors of performance (type of institute) rather than on the source of funds. Third, the number of research staff is used as an indicator of financial resources.

Difficulties arise particularly from the definition of researcher, which may have varied among the countries, and from the fact that not all researchers do full-time research work (e.g. university staff who also have educational duties). However, the number of researchers as a measure of national R&D efforts has the advantage of not being complicated by changes in currency values internationally and over time.

**Forestry research as forest policy and science policy**

Forestry research has a dual role in public policy. It may be considered both as a part of science policy and as a part of forest policy. In the European OECD countries, forestry represents 0.32 percent of the total graduate staff in R&D. Forestry research has the most important role in science policy in countries with smaller economies and a high level of forest cover (e.g. Finland, Sweden, Austria, Portugal and Norway). On the other hand, countries with fewer forest resources (e.g. Denmark, Ireland, the Netherlands, Iceland and Greece) place more emphasis on forestry research compared with other research fields than the major economies with significant forest resources (e.g. Germany, France and Italy) (Hellström and Palo, 1994; 1995a; Hellström and Palo in FAO, 1995).

The role of forestry research in public forest policy also varies greatly within different European countries. Grayson (1993) has evaluated the role of public research expenditure on behalf of private forestry in several Western European countries (Fig. 2). Belgium, for example, allocates nearly six times as much to research in favour of private forestry as it does in forestry grants.

However, the high share of research may be to some extent an overestimation, because funds for extension are not taken into account. Other rather research-oriented countries are the United Kingdom, France, Denmark, Sweden and Finland, which allocate 25 to 40 percent of their public support to private forestry for research. Ireland, Germany and Norway, on the other hand, place less emphasis on research as a form of public forest policy than other countries. In these countries, research represents less than 10 percent of the total public support to private forestry.

**Public versus private research.** In Europe as an average, 40 percent of forestry research is conducted at universities, 49 percent at public research organizations and 9 percent at private research organizations. The type of institute was not known for 2 percent of researchers, but the organizations marked as unknown are most likely to have been public research organizations. If Western European countries are considered alone, the share of forestry research conducted at private institutions is 15 percent.

European countries can be divided into five main groups according to the existence and dominance of various sectors of performance in forestry research (Fig. 3). The first group comprises Eastern European countries, where forestry research has traditionally been conducted at universities and national research institutes only. The second group consists of those Western European countries where no researchers in forestry are employed by the private sector (Greece and Ireland).

In addition to limited forest resources, these countries tend to have a small proportion of privately owned forests (17 percent in Greece and 22 percent in Ireland). The third group comprises the three European countries with the smallest forest resources (Cyprus, Iceland and Israel). In each of these countries forestry research is conducted only in a single public research organization with very few research staff (three to four graduates). The fourth group consists of a variety of countries with a rather small private sector in forestry research. The group is rather heterogeneous, consisting of both major and minor economies and of countries with small and large forest resources. The five countries of the fifth group (Sweden, Norway, Finland, Ireland, the Netherlands).
FIGURE 2
The structure of public expenditure in support of private forestry in some Western European countries, 1990-1994

FIGURE 3
Share of researchers in forestry by type of institution in European countries, 1983-1992

Notes: 1 Excluding costs on tropical forestry. 2 Including EC-funded projects. 3 Excluding arboriculture. 4 Excluding extension. 5 Excluding shelterbelts, hunting and landscape research. 6 Support for private forestry includes only funds from the Ministry of Agriculture and Forestry.

Sources: Data for Finland are from the Ministry of Agriculture and Forestry and Hellström (1995). Data from other countries are from Grayson (1993). Figures for Finland are from 1994, for Ireland from 1991 and for other countries from 1990.

Note: International Research Institutes are not included in the figure.
Portugal and Austria) all have substantial forest resources, and the private sector employed over 20 percent of the total forestry research staff in the period 1983-1992.

Research intensity
The two most common ways to describe research intensity is to compare research and development expenditures on the value added, or to the value of production. Here, such data were not available. Instead, the number of researchers per unit of production (m$^3$ of felling) is used as a crude indicator of research intensity (Fig. 4).

In countries with a high level of wood production (m$^3$ of felling), fewer researchers are employed per unit of production (m$^3$) than in countries with a low level of forestry production. In the countries with a high level of production, proportionately more research is done in the private sector than in other countries. Even though there is a great variation in the resources reserved for forestry research, the eight Western European countries with the highest level of wood production (Sweden, Finland, Germany, France, Spain, Austria, Norway and Portugal) have about the same number of researchers per unit of production, which is in fact the lowest of all the European countries. This equality is a most interesting finding. The Eastern European countries with the most significant wood production (Poland, former Czechoslovakia and Romania) have more researchers per unit of production than the Western European countries with a corresponding level of production. Several factors can be found to explain the high intensity of forestry research compared with units of production in other Western European countries. For example, many of the countries mentioned have a strong prior colonial tradition, which even today is reflected in their interest in research concerning tropical areas. In some countries, the environmental function of forests may be more dominant than in others.

Furthermore, forest resources may have a special value in countries where they are scarce, and the definition of “researcher” may also vary. For example, some countries may include technicians and other supporting staff in their figures, whereas others do not.

Case studies: Finland and Norway
The purpose of the comparative study between Finland and Norway (Hellström, 1995) was to:

![Figure 4: Number of researchers in the forest sector per unit of production in European countries, 1983-1992](image-url)
describe changes in funding of research in the forest sectors of Finland and Norway during the period 1983-1993;

• analyse the influence of both economic and institutional factors on the funding structure; and

• analyse the effects of different funding patterns on the activities of the research organizations.

Finland and Norway were chosen as case study countries for an in-depth investigation because the study offered a possibility to compare the effects of varying science policies on research that is otherwise conducted in rather similar circumstances.

The study involved ten research organizations in Finland and seven in Norway. Multiple sources of evidence were used. First, such factors as the pattern of funding, the client structure, the type of research projects, the organization as well as the dependency of the organization on other organizations were charted. This information was mostly drawn from annual reports and other publications. Second, information about the effect of economic and institutional factors that were likely to affect the level and pattern of funding as well as information about the effect of changing funding levels and patterns on research activities were collected through focused interviews of specialists in the organizations studied. Third, figures from national statistics on R&D were used to ascertain the research input of individual industrial enterprises.
Public versus private research
In both Finland and Norway, research conducted at universities represents only a minor share of research in the forest sector (5 percent in Finland and 4 percent in Norway). The major difference between these two countries is that, in Finland, a higher proportion of research in the forest sector (50 percent) is conducted in individual firms than in Norway (35 percent). On the other hand, in Norway relatively more research in the forest sector is conducted in research institutes (36 percent in public and 26 percent in private research institutes) than in Finland (28 percent in public and 17 percent in private research institutes). A further important difference is that the principal research institute for wood technology is public in Finland – the Forest Products Laboratory of the Technical Research Centre of Finland (VTT) – and private in Norway – the Norwegian Institute of Wood Technology (NTI).

Despite some structural differences in the organization of forest sector research in Finland and Norway, the funding structures of the various research fields are surprisingly similar (Fig. 5). In both countries, most funding for forestry research comes directly from the state budget. Owing to different accounting systems of research expenditure, all public research grants are included in the respective category in Finland whereas, in Norway, public research grants other than those of the Research Council of Norway (NFR) are included in the category of “other funding”. Thus, the only significant difference in the funding structures of forestry research for these two countries is that industrial membership fees are also used for financing forestry research in Finland (Metsäteho). In Norway, the forest industry is not involved in funding forestry research on a regular basis. This is because very little logging in Norway is conducted by the forest industry, which also owns relatively little forest area.

In wood technology, the share of public funding is roughly the same in both countries despite the very different organizational pattern of research in this field. The difference between these two countries is that in Finland, basic funding comes mostly from the government budget while, in Norway, it comes from NFR. A further distinction is that, in Norway, membership fees are also collected from the industry. Moreover, the funding structure of research in pulp and paper technology is very similar within the two countries.

Research intensity
Research intensity in forestry and wood technology, measured by using the share of research expenditure of the GDP as an attribute, is rather similar in both Norway and Finland. However, in the figures concerning forestry, the intensity of research is significantly overestimated in both countries because non-market products such as biodiversity, carbon balance recreation, are not included with production figures (Fig. 6).

Research intensity in pulp and paper technology is significantly higher in Finland than in Norway. One possible explanation for this is that the Finnish forest industry is to a large degree also involved in machine development.

Science policies and research activities
Forestry research in both Finland and Norway faced a period of significant growth during the 1980s. In the early 1990s, on the other hand, the total level of research funding decreased in Finland and stagnated in Norway. However, differences between single institutes are considerable. Generally, tighter funding results in two different kinds of policy: attempts to increase the efficiency of the use of funds and attempts to increase the level of funding from external sources. Even though both policies have been applied in both countries, it seems that the focus in Finland has been more on the first strategy while in Norway it has been on the second.

The research policies of both countries have raised pressure to increase private funding. In Finland, this pressure is mainly caused by decreasing public funding, and in Norway by the policy of increased user orientation. However, in the interviews reported in Hellström (1995), research leaders in both countries were pessimistic about being able to increase the share of private funding in forestry research significantly. Research fields affected most by the various changes in financing in both countries are those using long-term field experiments.

DISCUSSION

Theory and empirical findings
The empirical findings of the studies presented in the previous section have generally been consistent with the economic criteria for a rational division of public and private funding of forest sector research presented at the beginning of the article. However, data for the studies were collected on an institute-wide basis, and not according to individual fields of research, which to some degree restricts the scope of conclusions on the basis of these studies.

According to support from the European survey of public and private forestry research (Hellström and Palo, 1994; 1995a; 1995b; Hellström and Palo in FAO, 1995), the following conditions were considered to be the most relevant for private funding of forestry research:

- a high rate of return of research investment;
- a short delay and low risk of R&D investment (e.g. forest products research, harvesting);
• a concentrated, capital-intensive forest industry (e.g. Scandinavia);
• large private forest holdings (e.g. Portugal); and
• strong forest owner unions (e.g. Denmark).

Despite a clear need and the existence of private forestry research organizations in some well-defined research areas, there remains a wide range of aspects that favour public funding of most forestry research:

• missing markets for research results;
• imperfect juridical infrastructure (e.g. patent system, property markets);
• positive external effects in the form of innovations;
• forest environment as a public good;
• positive distributive effects in favour of rural areas;
• stabilization of an economy in recession; and
• sustainability of R&D funding – scientific standards.

These criteria are discussed below in relation to experiences in some research fields. For most biological forestry research, the conditions of short delay until payoff and low risk of investment are not fulfilled. Yet, investments in forest management intensification techniques, such as fertilization and drainage, can produce gains within a shorter time span than most other biological research. Another important factor affecting the existence of the private sector within biological forestry research is the forest ownership pattern. Generally, forest owners cannot be expected to finance biological forestry research, except in the case of very large forest holdings, such as those within the forest industry in Portugal, or in the case of strong forest owner unions (e.g. Denmark). In fact, public funding dominates most areas of forestry research, which is also supported by the fact that many areas of forestry research produce high social gains.

In the case of engineering-related harvesting and transport, the delay until payoff is short, and the private sector can be expected to be involved with research funding. However, much depends on the employment structure in harvesting and forestry work in a specific country. In several European countries, private funding of harvesting-related research does not seem to have a regular basis, but is focused on contract research on individual projects. Cubbage (1989) reports a similar situation in the United States where, in spite of the economic efficiency of research in harvesting, there is a paucity of funding and research scientists. On the other hand, in Denmark harvesting is mostly conducted by owners of small forest holdings, who also finance an institute conducting research in harvesting through a strong forest owners’ union. Furthermore, in Finland and Sweden, where a large share of forest work is conducted by the forest industry, it is the industry that is largely involved with research in harvesting methods. On the other hand, in Norway, most forest work is conducted by the numerous private forest owners, so the private company sector does not have the same incentive to invest in forestry research as in Finland and Sweden.

A particularly interesting finding in the comparison of research funding in Finland and Norway is the fact that, despite some differences in the organizational structure of forest sector research, the funding structures of forestry, wood technology and pulp and paper technology are very much alike in both countries. This suggests that economic criteria, such as those presented above, strongly guide the funding structures of forest sector research despite variations in organizational structures.

This can be illustrated by an example of wood technology research. In Finland, such research is conducted at the Forest Products Laboratory of the Technical Research Centre of Finland (VTT) – a public institute that enjoys substantial public involvement in research funding. The Norwegian wood industry, on the other hand, has a joint research institute: the Norwegian Institute of Wood Technology (NTI). As public support for this institute has decreased it has become increasingly dependent on funding from the fragmented wood industry which has not been able to provide a sufficient level of funding for basic research. Thus it seems that, regardless of the ownership structure of research institutes within wood technology, regular public support is necessary owing to the fragmentation of the industry. Another main reason for the continued need for public funding compared with the pulp and paper sector is the relatively inelastic demand of sawnwood which considerably restricts the producers’ gain from innovations and gives most of it to the users of sawnwood.

On the other hand, private involvement in research funding in pulp and paper technology is dominant in both Finland and Norway, partly owing to the concentrated and capital-intensive pulp and paper industry in these countries, and to the relatively elastic demand for pulp and, particularly, paper products.

Recommendations

Privatization of the funding of forestry research has often been motivated by the scarcity of public funding and the need to increase the productivity of research. However, both economic theory and our empirical findings give strong support for the continuing dominance of public funding for most forestry research. We have not found support from theory or practice that decreased public funding of most forestry research would be compensated by increased private funding in the respective fields of research. In addition, if public funding of forestry
Privatization of decision-making in forestry research is mainly to improve the linkages between the producers and users of research results, in order to promote the learning process necessary to produce innovations. The science policy of the Norwegian Research Council (NFR) aiming at increased user orientation can be seen as an example of this third form of privatization. In the new policy, the degree to which the use of public funds is made within the private sector has been increased. However, NFR’s privatization strategy also includes the first form of privatization by increasing private funding of research and development. Overall, the policy seems to have been successful in improving the interaction between the producers and users of research results.

However, as a consequence of the new policy some research institutes have faced a situation where adequate funding is no longer available for a sufficient level of basic research to maintain scientific competence. A further problem in user-steered research is that less priority is given to the quality of research. A third problem is that research capacity has not increased and the freedom of research may have decreased.

Privatization of research has a negative connotation for many scientists, as it is often feared to lead to decreased freedom and objectivity of research. Without underestimating these problems that have come forth in the empirical evidence, it should be emphasized that there are many forms of privatization with varying effects on research activities, not all of which could be presented in this paper. Research leaders should therefore carefully consider the various forms of privatization and the motivations for such action in order for the sustainability needs of forestry research to be satisfied. A sustainable level of research funding is necessary not only for a stable amount of research, but also for the maintenance of scientific quality and neutrality and for maintaining and increasing the value of previous investments in long-term research projects.

In the opinion of the authors, pressures for decreased public funding could be confronted with active debate on behalf of sustained or even increased public funding of forestry research. The criteria for public and private funding presented previously could form an important basis for such argumentation.

Even in countries such as Finland and Norway, which have significant forest resources, research intensity in the forest sector is only slightly above the European average, and in wood technology even significantly below the average. Yet, because the high value of non-wood benefits of forestry is not considered in the figures cited for research intensity, these figures significantly overestimate the real situation. The research intensities in Finland and Norway are slightly lower than in most other major wood-producing Western European countries. These facts leave considerable scope for increasing research funding in both forestry and wood technology in several European countries, particularly in Finland and Norway.

Owing to the reduction of grants for forestry in some Western countries during recent years, the relative role of forestry research in public forest policy has increased. In fact, R&D in forestry could be increasingly regarded as one of several instruments of forest policy. In many cases, investments in R&D might produce larger gains for forestry than poorly designed subsidies. Again, the criteria set for private and public funding of forestry research could be considered as the primary criteria for balancing investment in R&D with investments in other instruments of forest policy. In fact, increased public investments in forest sector research and development could
be considered the most effective policy means to promote economic growth and development.

Bibliography


Reconsidering the extent of deforestation in twentieth century West Africa

J. Fairhead and M. Leach

This article suggests that the extent of deforestation that has occurred in West Africa during the twentieth century is currently being exaggerated. It presents key findings of detailed research into vegetation change over the past century in Côte d’Ivoire, Sierra Leone, Liberia, Ghana, Togo and Benin.

Many estimates of West African forest cover change have been made during the twentieth century. In this article, which very briefly summarizes a more extended and fully referenced work (Fairhead and Leach, in press), we argue that recent estimates have hugely exaggerated the extent of forest decline since 1900. Forest loss during this period may be only one-third of the figures currently circulating in international scientific works. While analyses of present vegetation cover and of change over the last decade might be increasingly precise, making use of multiple data sources and remote sensing (FAO, 1996; Sayer, Harcourt and Collins, 1992), the same cannot be said for the assessments of past forest cover with which these analyses are compared. We suggest that, when investigating past cover, forest loss assessments have either used historical sources uncritically or have not used historical data at all. Indeed, most authors find it acceptable to make suppositions concerning the nature and extent of earlier vegetation or to make uncritical reference to other studies that do this. In particular, it has become acceptable to deduce the nature and extent of past forest cover and the time scale of its loss, from observations of present

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vegetation, coupled with several presumptions: i) that everywhere that forest could exist today (under given climatic and soil conditions), it originally did exist in a pristine form until it was degraded to today’s state or lost completely to savannah; ii) that this loss was principally caused by people’s land use activities; iii) that inhabitation of forest land is relatively recent (generally since around 1900); and iv) that earlier farming and land management were either insignificant or benign for the forest.

Analyses of forest cover change are beset by problems of definition, and much forest can be lost or gained in the translation between definitions. One aim of our analysis has been to identify instances in which academics or policy-makers have been misled (or have misled others) by such “definitional deforestation” (or afforestation). Nevertheless, in this study, following Hall (1987), forest is generally characterized as “vegetation dominated by trees, without a grassy or weedy understorey, and which has not recently been farmed”. Thus defined, forest includes logged-over areas but is readily distinguishable from savannas. We also circumscribe our concern to forests characteristic of West Africa’s humid and semi-humid zones. This general definition is broadly in keeping with analyses incorporated into FAO’s 1980 Forest Resources Assessment (FAO, 1981), but not with its 1990 assessment (FAO, 1993). The latter incorporates as “moist forest” very large areas which are not conventionally defined as such in West Africa, rendering the figures totally incomparable with earlier sources. Instead, for 1990 data we draw principally on other recent assessments synthesized by the World Conservation Monitoring Centre (Sayer, Harcourt and Collins, 1992).

We have attempted to seek more precision concerning vegetation cover at different dates by using early landscape descriptions, air photographs and maps and oral evidence. Our aim has been to shed light on forest loss and forest ecology from historical sources rather than to interpret forest history from ecological sources. This endeavour was prompted by our earlier study in Guinea (Fairhead and Leach, 1996) which revealed a striking contrast between the assessments of vegetation change in scientific and policy documents and historical evidence. In Guinea’s Kissidougou prefecture, during the past century – the period in which today’s analysts consider there to have been the most forest destruction – forest areas had actually increased at the expense of savannah.

Historical and social anthropological research showed that the same observations that scientists and policy-makers had been taking to indicate deforestation were properly interpreted as indicating anthropogenically assisted forest establishment. In particular, forest islands located in savannah were found to owe their existence to inhabitants who had encouraged them to form around savannah settlements. Forest patches were therefore not the relics of a larger past forest, as they had been taken to be. Our research also showed how farmers had established forest fallow (farm bush) in what had earlier been grassy savannahs and that forest thicket fallows, therefore, were not degraded forest as had been thought. Furthermore, we found how oil-palms were being established in savannahs, rather than being relics left after the conversion of forest to savannah.

Drawing on these insights and historical works we have examined critically the evidence for forest loss during the twentieth century in several West African countries. Here we briefly review our findings concerning forest cover change in Côte d’Ivoire as a way of exemplifying the problems in forest cover data and then, even more briefly, summarize our findings from Sierra Leone, Liberia, Ghana and Benin.

CÔTE D’IVOIRE
Following FAO’s 1980 Forest Resources Assessment (FAO, 1981), Côte d’Ivoire acquired the reputation of having the highest rate of deforestation in the tropics. Numerous articles appeared between 1978 and 1984, using the same data – summarized in Table 1 – and drawing the same conclusions (Monnier, 1981; Bertrand, 1983; Arnaud and Soumia, 1978; Myers, 1980). These works continue to influence more recent statements concerning Ivorian forest cover change during the present century (Parren and de Graaf, 1995; Sayer, Harcourt and Collins, 1992; Myers 1994).

The data for forest area in 1955 and 1965 were produced following a major evaluation of national timber potential by the Centre technique forestier tropical (CTFT, 1966; Lanly, 1969). The data for 1980 were based on the 1966 analysis but updated in the light of agricultural land use statistics. FAO (1981) supplies no evidence for the figure for 1900, it being the presumed area of the “forest zone”, considered then to be more or less intact by the authors. Yet, neither the figure for 1900 nor those produced for 1955, 1965 and 1980 are comparable with other sources. We thus illustrate our approach with data for the period 1900 to 1990 for the forest area in Côte d’Ivoire, as presented in Table 1.

Table 1. Dense humid forest cover change in Côte d’Ivoire

<table>
<thead>
<tr>
<th>Date</th>
<th>Area (million ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 1900</td>
<td>14.5</td>
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<tr>
<td>End 1955</td>
<td>11.8</td>
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<tr>
<td>End 1965</td>
<td>9.0</td>
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<td>End 1973</td>
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<td>4.0</td>
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<tr>
<td>End 1990</td>
<td>2.7</td>
</tr>
<tr>
<td>Total loss since 1900</td>
<td>11.8</td>
</tr>
</tbody>
</table>

1 Figure from Sayer, Harcourt and Collins (1992). Source: FAO (1981).
and 1980 can be accepted. All subsequent analyses, therefore, have serious shortcomings in their assessment of past vegetation cover.

The 1966 study used the complete air photographic cover of Côte d’Ivoire for 1954-1956, as well as maps based on it, to calculate the area of the forest zone and the percentage of dense forest. The forest cover for 1966 was then calculated by comparing the proportion of land under forest in a sample of comparable 1956 and 1966 photos. It was concluded that the Ivorian forest cover had declined from 75 to 54 percent of a 13.1 million ha zone (Lanly, 1969). The study did not cover the extreme southwest, containing a higher proportion of forest than the rest of the country, but when this had been taken into account it was found that the forest cover had declined from 11.8 million ha in 1955 to 9 million ha in 1966.

There are, however, several reasons to doubt this figure. First, it seems hard to match the assertion that 75 percent of Côte d’Ivoire’s forest zone was forest in 1955 with the observations made in the 1950s by both Aubreville and Mangenot, colonial foresters who knew Côte d’Ivoire well. Mangenot (1955, p. 6-7) suggested that, except for the southwest (about 2 million ha of forest), “the reserves of the forest department represent almost the only intact specimens permitting today the study of the dense forest” ... and that “botanists often have some difficulty finding mature forest”. Forest reserves (then 4.5 million ha) and forest in the southwest together represented only 6.5 million ha (40 percent of the supposed forest zone). Significantly, Aubreville...
himself estimated the area of Ivorian forest in 1950 to be only 7 million ha (Aubreville, 1959).

These authors were, it seems, distinguishing forest (whether it was logged-over or not) from other land uses. Mangenot (1955) was explicit about the illusions that the incautious observer might hold about Ivorian forest cover. He wrote:

“Seen from the summit of a hill, the landscape appears as a sea of trees ... but when one ... travels over it following the tracks, one sees that over vast areas this actually corresponds with a corpse: the forest has been destroyed, with only a few large trees surviving, in whose shade are palm, coffee, cocoa, and cola plantains, and fields of manioc and yam. Each village is therefore at the centre of a zone not dewooded – large trees exist everywhere, and species cultivated are small trees, bushes and giant forbs, but deforested. High forest has been replaced by a mosaic of plantations, fields and bush fallows of small secondary woods.”

That the CTFT-derived study exaggerated forest cover in 1955 is also suggested by several other sources. A second analysis of Ivorian forest cover was conducted almost simultaneously in 1967 (Guillaumet and Adjanohoun, 1971), from whose maps an estimate of forest cover could be made (although the authors themselves do not make such an area estimation), FAO (1981) and the United Nations Environment Programme [Ed. note: UNEP supported the 1980 Forest Resources Assessment] argue that the data from this study confirm the assessment in Lanly (1969) because, from its maps, it appears that a similar forest cover of approximately 8.8 million ha can be inferred. Yet the forest cover map in Guillaumet and Adjanohoun (1971) was actually drawn up from the 1954-1956 air photographs. Thus, rather than supporting the figure for 1966 in Lanly (1969), they undermine its figure for 1955 by suggesting that, in 1955, Côte d’Ivoire had approximately 8.8 million ha of forest.

A further reason to question FAO estimates of Ivorian deforestation derives from early colonial assessments of forest cover. While certain global forest analysts such as Breschin (1902) and Zon and Sparhawk (1923) assumed that the majority of the Ivorian forest zone was forest – works which have misled certain modern authors – other early Ivorian specialists were not as naive. Meniaud (1930) was explicit. Under the heading “Statistical errors concerning the surface of ‘Grand Forêt’, the empty spaces in the interior of the extreme limits, and the reasons for these spaces,” he suggested that: “The areas generally given in statistics as being occupied by the high forest are calculated according to the extreme limits, [that is] 11 million ha for the high forest of Côte d’Ivoire.” By taking into account farmed and savannah areas in the forest zone, Meniaud calculates that “the primary forest, or that which is exploited only by the export timber industry” totalled only 8 million ha. Lower figures still were suggested by Chevalier (1909), who estimated only about 6 million ha, and by Gros (1910), who estimated between 7.2 and 7.8 million ha.

Consideration of the relationships between population and land use should also force us to question assertions of such high forest cover in 1955. To the west of the Bandama River, rice is a major crop and, in these regions, Chevalier (1909) calculated that population densities of only about seven people per km² were sufficient to cultivate the entire territory under rotational bush
fallowing with preferred fallow lengths of 12 to 15 years. As he said, “this is no exaggeration as, around villages of about 200 people, the forest is destroyed in a radius of between 5 and 7 km”. In 1955, three regions west of the Bandama River far exceeded such population densities: Daloa, 7.2/km²; Man, 10.6/km²; Gagnoa, 16.4/km². The other two regions in the extreme southwest (Sassandra, 2.2/km² and Tabou, 1.6/km²) had smaller populations, in keeping with descriptions of these areas which were the last forest reserves. Even allowing for the fact that Chevalier may have exaggerated, these densities must have had a significant impact on forest cover. The east also had significant populations. In the Moronou region around 1900, there were at least 62 villages in an area of approximately 350,000 ha (Ekanza, 1981). If each village only used land within a 4 km radius, the entire land area would be used. Similar village and population densities were found throughout the Aoussoukrou and the Ouellés regions of the forest zone between the Nzi and Comoé Rivers. Some areas would have been more and others less inhabited, leading to a vegetational mosaic of forests and fallows of different ages, merging with cola, palm, plantain and other plantations. However, it would be completely incorrect to consider this region to have been merely forest.

Furthermore, it is unlikely that forest cover in 1900 was much more than it was in 1955. Quite possibly it was less. Large parts of the forest existing in the mid-twentieth century may have been regrowth on land that had been under farming earlier. Many parts of the forest region were depopulated between 1900 and 1912 during the colonial wars between French forces and the Baoulé, Dan, Bete, Guro and Dida peoples. These peoples inhabit a huge region of the Ivorian forest zone. The effect of these wars on the Baoulé people who live on the forest margins is the best documented. Their population suffered an enormous decline from about 1.5 million in 1900 to 225,000 in 1916 (Weiskel, 1980, p. 208-209), a huge loss when compared with official population figures for the entire country in 1921, which stood at 1.5 million, rising to only 2.5 million in 1955.

It was not only the Baoulé whose population fell. For example, a third of the population of Guiglo in the southwest fled into Liberia at the time of the French occupation, and the depressed populations in that part of the southwest did not increase between 1906 and 1972. The demographic shocks of the early colonial period were compounded by illnesses such as the 1918-1919 flu epidemic, and labour shortages engendered by the conscription of soldiers for the First World War forced labour for portage and road-building. Farming areas thus abandoned would have succumbed to forest regrowth. While many observers noted huge forest losses near roadsides before independence, this is largely because the colonial regime had forced the Ivorian population to move to roadside villages and to abandon earlier settlements.

Each of these historical sources might be questioned, whether it be on the grounds of subjectivity, site-specificity or ambiguity of definitions. But, together, they certainly challenge present-day assertions that Côte d’Ivoire had 14.5 million ha of forest in 1900 and also seriously question the figure of 11.8 million ha for 1955.

One further question emerges concerning the area of the “forest zone”. By 1909, Chevalier asserted that the limits of the Ivorian forest zone were known and the area was about 12 million ha, while others provided figures of between 11 million and 13 million ha. All modern analysts, however, suggest that the forest zone is significantly larger, at about 15.7 million ha.

This discrepancy can be explained partly by early authors’ tendency to consider a strip of land (1 million ha) situated 20 km...
inland from the coast as lying outside the forest zone because it lacked forest owing to its lagoons, littoral savannahs or farmlands. More important, about 2 million ha on the northern margins of the forest zone, which carry savannah or a forest-savannah mosaic, are today considered to lie within the forest zone (as they “ought to carry forest”). Yet, in 1912 they were classified as being outside it. Early descriptions of the landscape clearly show that these areas did not carry extensive forest at the turn of the century. To say that they have been deforested since 1900, as many modern authors assert, is therefore erroneous.

Moreover, there is evidence that the area of the zone dominated by forest (and forest-fallow) vegetation in Côte d’Ivoire has been increasing in recent centuries, not contracting, in relation to savannahs. Several oral accounts suggest that areas that are now well within the forest zone have been savannah around 300 years ago. But such a vegetation history is entirely consistent with recent ecological findings in Côte d’Ivoire. In the Baoulé savannahs, villagers say that “where one cultivates, the forest advances”, and research on forest dynamics at the forest-savannah boundary show just that (Spichiger and Blanc-Pamurd, 1973), while elders affirmed to Adjanohoun (1964) that savannahs that once existed within the dense forest have today disappeared under forest. Yet undergoing “savannization”, “it is the forest which gains on the savannah, and this despite their action” (cf. also Spichiger and Lassailly, 1981).

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Each of these issues forces one to question orthodox figures concerning deforestation since 1900. On the basis of the critique outlined above, we forward tentatively the alternative forest cover scenario elaborated in Table 2. This suggests that forest cover loss in Côte d’Ivoire during the present century may have been only half of what present authors consider it to have been.

SIERRA LEONE
Several authors have asserted that Sierra Leone has been deforested recently (Sayer, Harcourt and Collins, 1992; Nyerges, 1987). Myers (1980), for example, asserted that “as much as 5 million ha may still have featured little disturbed forest as recently as the end of the Second World War. It is a measure of the pervasive impact of human activities that the amount of primary moist forest now believed to remain is officially stated to be no more than 290 000 ha.” Yet such assertions are absurd, and with it the implied damning of African farmers, as several foresters at the turn of this century estimated forest cover even then to be only 100 000 to 200 000 ha, or approximately 1 percent of the land area (Unwin, 1909; Lane-Poole, 1911). Other modern assessments of forest cover change have been aware of this and date deforestation to a period between 1816 and 1860, when Sierra Leone became a timber exporter (Dorward and Payne, 1975; Millington, 1985). Such analysts to be no more than 290 000 ha.” Yet such assertions are absurd, and with it the implied damning of African farmers, as several foresters at the turn of this century estimated forest cover even then to be only 100 000 to 200 000 ha, or approximately 1 percent of the land area (Unwin, 1909; Lane-Poole, 1911). Other modern assessments of forest cover change have been aware of this and date deforestation to a period between 1816 and 1860, when Sierra Leone became a timber exporter (Dorward and Payne, 1975; Millington, 1985). Such analysts

<table>
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<th>Date</th>
<th>Area¹ (million ha)</th>
<th>Reconsideration (approx.) (million ha)</th>
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<tr>
<td>Total</td>
<td>11.8</td>
<td>5.3-7.3</td>
</tr>
</tbody>
</table>

¹ Data from FAO (1981).
² Data from Sayer, Harcourt and Collins (1992).
treat supposed timber-led deforestation in Sierra Leone, with farmers settling in its wake, as a nineteenth century precursor to a phenomenon followed elsewhere in West Africa in the twentieth century. Yet neither analysis of the quality and quantity of timber exported nor of demographic movements can uphold this conclusion (Fairhead and Leach, 1997). Insufficient timber was exported to account for even 2 percent of the supposed area afflicted. In short, if there was little timber following timber felling, this is simply because there was little there in the first place, a conclusion fully supported by accounts of the coast and interior early in the nineteenth century. The whole question of “deforestation” in Sierra Leone needs to be radically rethought.

LIBERIA
Several authors assert that “within living memory”, i.e. around 1900, the vast bulk of Liberia was covered with mature forests (Dorm-Adzobu, 1985), and such exaggerated claims of past cover have inflated deforestation estimates. Gornitz and NASA (1985) suggest that, around 1900, forest cover was 6.5 million ha, and Parren and de Graaf (1995) 7.3 million ha. But evidence from analysis of complete and ground-truthed air photographic cover in 1947 suggested: i) that there was a 3.5 million ha area of high forest and 1.9 million ha of broken bush (a forest of broken canopy partially cut for agriculture), adding up to an optimistic figure of 5.4 million ha of something that could reasonably be called forest; and ii) that forest areas had been increasing, not decreasing, over the first half of the century up to that date, as they also had been over the previous 300 years as populations had declined (Mayer, 1951, p. 16). Indeed, Mayer’s impression of Liberia, then, was of an “over-used, worn-out country of great antiquity”. Some works have exaggerated deforestation by underestimating present forest cover. For example, FAO (1981) estimated Liberian high forest cover to have been 2 million ha (and to have been 1.7 million ha in 1985), whereas several more recent analyses based on air photographic and satellite imagery put the figure at 4.4 million to 4.8 million ha – forcing us to question the reasoning behind the FAO (1981) calculations. In short, rather than having lost between 4 million and 4.5 million ha of forest this century, with only 17 percent remaining (Gornitz and NASA, 1985), it is likely that Liberia may only have lost 1 million ha, with more than 44 percent remaining.

GHANA
Many published works and national and international policy documents suggest that Ghana’s forest zone (now defined as 8.6 million ha) was intact forest around 1880 (Fair, 1992; Ebregt, 1995; Parren and de Graaf, 1995). The fact that there are only about 1.7 million ha of forest today, that this exists only in reserves and that only about half of these are themselves in “reasonable condition” suggests a precipitous decline. As for Liberia and Côte d’Ivoire, that there has been a decline this century is undeniable, but has it been on this scale? Data from Parren and de Graaf (1995) suggests a precipitous decline. As for Liberia and Côte d’Ivoire, that there has been a decline this century is undeniable, but has it been on this scale? Data from the early colonial period suggest that the area defined within the closed forest zone was about 7 million ha, of which no more than 5.5 million ha could have been forest. Furthermore, most of the forests early in the twentieth century were not in good condition. For example, when Thompson surveyed Ghana’s forests in 1909, he found that “comparatively few tracts are covered with so-called primeval or virgin forest; the majority... consist of secondary irregular growth that has sprung up on areas previously cleared for farms” (Thompson, 1910, p. 147). Furthermore, as in Côte d’Ivoire, there is evidence that the area of the forest zone has increased in recent centuries. In the transition zone, many reserves that are closed forest today were savannah woodland early in the century, and oral accounts suggest that areas now well within the moist, semi-deciduous forest zone (e.g. 30 km south of Sunyani) had extensive grasslands around 1700. Furthermore, historical sources suggest that, owing to depopulation in many zones (linked perhaps to climatic humidification), the area of forest in 1900 may have been larger than it had been in 1600-1700.

BENIN
Gornitz and NASA (1985) are not alone in suggesting that Benin’s forest was intact up to 70 km inland from the coast at the turn of the century (approximately 1.1 million ha). Yet sources from the beginning of the century suggest otherwise. A 1:100 000 map detailing dense vegetation exists for 1893 and suggests that only about 30 percent of this area was then covered in dense vegetation. When ground-truthed contemporaneously with the accounts of early botanists in the region, one finds that this dense vegetation was not forest, but palm grove. As Chevalier noted, “the palm covers all the land... In some places, the uncultivated bush seems to dominate, but when one examines it closely, one finds that this bush covers land in fallow, and among the trees and bushes, live oil palms in close ranks” (Chevalier, 1912). Furthermore, Chevalier and, later, Aubreville describe how farmers established much of this palm grove in savannah. While those arguing for deforestation suggest that its relics remain in the occasional patch of forest that can be found, these forest islands are generally associated with sacred groves, and a good case can be made that most of these forests have either been established or enriched artificially and/or have grown on the abandoned sites of towns or villages.
TABLE 3. Suggested revisions to
deforestation estimates since 1900

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<tr>
<th>Country</th>
<th>Orthodox figures</th>
<th>Suggested figures</th>
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<tr>
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<td>Total</td>
<td>25.5-30.2</td>
<td>9.5-10.5</td>
</tr>
</tbody>
</table>

*Since 1820.*

where habitation has made the soils extra fertile. Equally, as in the other countries discussed, analysts who have seen species of trees characteristic of forest (e.g. *Milicia excelsa*, *Antiaris toxicaria*, *Ceiba pentandra*) standing alone with tall straight boles have incorrectly deduced that these trees acquired their form when growing within a forest of which they are therefore a relic. Yet these (and many other) forest trees can acquire a forest form even when growing in isolation, and they are among those frequently encouraged by West African farmers for growing in fields. A debate has already raged over the extent to which Benin was deforested between the sixteenth and nineteenth centuries (Gayibor, 1986; Blanc-Pamard and Peltre, 1987), and assertions of massive forest loss over this period can be rejected.

CONCLUSIONS

Deforestation during the twentieth century has, we suggest, been significantly exaggerated in every country covered by our research. As Table 3 summarizes, it may well be only about one-third of currently orthodox estimates. It also seems likely that the period from 1900 to 1920 was a high point in forest cover in several countries (certainly for Liberia and Ghana and perhaps also for Côte d’Ivoire) following the decline of earlier farming populations, and forest loss might therefore appear to be even less were it possible to take an earlier baseline.

The forests of the West African countries studied here form only a fraction of Africa’s and the earth’s totals. Presumably, the same methods which have led to the exaggeration of deforestation in West Africa this century are used elsewhere. We would also argue that the institutional structures of today’s forestry and conservation circles seem to favour the production of exaggerated statistics for forest loss. This implies that data on deforestation everywhere need to be examined more critically and compared with the evidence that a close examination of historical sources can provide.

Exaggerated claims of deforestation have misled ecologists. They obscure how far present forest ecology and composition may reflect “nature and its degradation” less than real histories of climatic fluctuations in interaction with past land management. In particular, in West Africa, claims of one-way deforestation have completely obscured what seems to have been a large increase in the area of the forest zone in recent centuries. Moreover, exaggerated estimates of deforestation on this scale will also mislead regional and global climatic modelling. And exaggerated estimates of deforestation have other more problematic consequences: they obscure appreciation of how farmers may have been enriching and stably managing their landscapes; they obscure the historical experience of inhabitants and the origins of their claims to land; and, most significant, they have often unjustly supported Draconian environmental policies that further impoverish people in what is already a poor region.

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The sustainability of wood production in plantation forestry

J. Evans

Accurate evidence about the sustainability of plantation forestry is needed, since future supplies of forest products will increasingly come from intensively managed forests and plantations. This article reviews available evidence and reports recent findings from a comparison of three rotations of pine in the Usutu Forest, Swaziland.

The concept of sustainability is central to sound forest management and the subject of much current debate. In the case of forest plantations established with the specific purpose of producing wood, whether for industrial purposes or domestic use, the question must be asked, can supplies be maintained in perpetuity? This biological or "narrow sense" sustainability must first be satisfactorily addressed, then the technology of plantation silviculture can fulfil the worldwide potential expected of it with some assurance.

THE IMPORTANCE OF PLANTATION FORESTRY AND SUSTAINABILITY

Although estimates vary, the total area of forest plantations in the world amounts to between 120 million and 140 million ha. What is more certain is that this area is increasing in both temperate and tropical countries. In the tropics especially, the present rate of plantation establishment (2 million to 3 million ha per year) is double that recorded in the 1960s and 1970s (FAO, 1992; Evans, 1992). The main purpose of such plantations is either for industrial production or domestic use as building poles, fuelwood and fodder.

A great majority of forest plantations are of uniform age and composition (monoculture) and most are managed to optimize the yield of wood from a site. Clear-felling and replanting is the most common silvicultural system although, where appropriate, coppicing is used as a means of restocking. These features of plantation silviculture have raised concern that many of the sites on which trees are planted may be incapable of sustaining their productivity. Models of nutrient export, examination of physical damage of soil structure and claims of greater risk from pests and diseases have all been advanced as hypotheses for the inherent unsustainability of intensive plantation forestry.

The question of sustainability, at least in the narrow biological sense, has long
been a concern in agriculture, particularly with arable cropping. Several long-term experiments are being carried out in different countries, of which the oldest and most famous is Broadbalk Field at Rothamsted Experimental Station, Harpenden, United Kingdom. Since 1843, successive crops of wheat have continuously been grown and assessed. Over a long period, yields from the control treatment, which has received no fertilizer and only minimal cultural treatment to control weeds, have remained low but stable (Johnston, 1994). This work has shown that, even after 150 years, the land itself has not become “wheat sick” and that low yields arise from low external inputs (although these are rising, notably anthropogenically derived nitrogen mainly found in rainfall which has now reached as much as 30 kg/ha⁻¹/year⁻¹).

Factual evidence concerning long-term productivity of forest plantations remains meagre by comparison but, without it, foresters cannot properly demonstrate how robust their silviculture is and cannot refute suggestions that successive rotations of fast-growing trees inevitably lead to soil deterioration. This article examines the evidence of yield decline and reports in detail on the best data sets in the world which describe the performance of three successive rotations on the same site (Evans, 1996). The subject was reviewed by the author at the Eighth World Forestry Congress held in Jakarta in 1978 (Evans, 1978). Since then significant new information has arisen which is germane to the question of sustainability.

**MENSURATIONAL EVIDENCE OF THE PRODUCTIVITY OF SUCCESSIVE TREE CROPS**

A full review of this subject in Evans (1990) revealed how few examples exist of demonstrable and widespread yield declines, excluding those attributed to pollution and pathogen-related dieback (Ciesla and Donaubauer in FAO, 1994; Freer-Smith, in press). Three main examples have been reported in the forestry literature.

**Spruce in Saxony and other European evidence**

Reports by Weidemann (1923) suggested that in the 1920s significant areas of second and third rotation spruce (*Picea abies*) in lower Saxony, Germany, were growing poorly and showed symptoms of ill-health. This much-researched decline was attributed to insect defoliation, air pollution, the effects of monoculture and, simply, the intensive form of forestry practised. It is now clear that much of the
A problem arose from planting spruce on sites to which it was ill-suited, as also happens with silver fir (Abies alba). Elsewhere in Europe reports of localized yield decline in Denmark, the Netherlands and the Landes area of France have appeared but neither the extent nor magnitude of yield change were cause for concern. In Great Britain most second rotation crops are equal to or better than those of the first rotation and, in the case of restocking with Sitka spruce (Picea sitchensis), by far the most important species in the uplands, there has been no need to reapply phosphate fertilizer even though it was essential for establishing the first rotation (Taylor, 1990).

Today, many forest stands in Europe are showing growth increases compared with the past for reasons that are not entirely clear but may reflect better silviculture and rising CO₂ and NO₃ concentrations in the atmosphere (Spiecker et al., 1996).

Pinus radiata in South Australia and New Zealand

The first reports of significant productivity decline emerged in the early 1960s (Keeves, 1966) and by the end of the decade it was clear that, throughout the state, a productivity falloff of about 30 percent was occurring in the second crop. Not surprisingly, the problem generated a great deal of research and it gradually became clear that a combination of factors was causing the poorer growth of the replanted second rotation. Harvesting and site preparation practices, e.g. windrowing, were causing great losses of organic matter from sites and high weed-seed loads combined with inadequate weed control were leading to extensive grass invasion. Experiments showed that the conservation of organic matter and more gentle handling of a site, along with adequate weed control, greatly improved performance of the second rotation and largely overcame the decline problem. Today, these and other changes in silviculture have eliminated decline altogether (Woods, 1990).
In restricted areas of New Zealand, second rotation decline in *P. radiata* was also reported (Whyte, 1973) but was confined to impoverished sites in the Nelson area of the South Island. Elsewhere, a carefully investigated study of second rotation *P. elliottii* in Queensland, Australia, showed no evidence of yield decline. Nor has any such decline been reported among subtropical pines in southern Africa, apart from a highly localized and site-related occurrence in Swaziland (Evans, 1996).

**Cunninghamia lanceolata in China**

About 6 million ha of plantations of Chinese fir (*C. lanceolata*) have been established in subtropical China. Indeed it is the most widely planted species. Most plantations are monoculture and are worked on short rotations to produce small poles, although the tree itself, its foliage, bark and sometimes even its roots, are all utilized in some way. Reports of significant yield decline began to appear some years ago: accounts by Li and Chen (1992) and Ding and Chen (1995) suggest a drop in productivity between first and second rotation of around 10 percent and up to a further 40 percent between the second and third rotations. Data have been difficult to obtain to indicate how widespread this kind of decline is, but the importance attached to it by Chinese foresters is evidenced by a large amount of research into questions of monoculture, allelopathy, soil changes, etc. It appears that the practice of whole-tree harvesting, the almost total removal of organic matter from a site after harvesting and conditions that favour extensive grass and bamboo invasion all contribute substantially to the problem. The effect of allelopathy and recruitment of coppice shoots for restocking on productivity remains unresolved. Yield decline in Chinese fir has been the subject of a cooperative research investigation by the United Kingdom Overseas Development Administration and the Chinese Academy of Forestry.

**Coppice**

Plantations of some species, e.g. eucalypts, are often managed by coppicing for the second, third and sometimes fourth rotation. Much evidence indicates that, typically, the first coppice crop is the most productive, followed by poorer yields in each subsequent crop until replanting. Kaumi’s 1983 report from Kenya and that of Jacobs from India in 1981 are typical (Kaumi and Jacobs, cited in Evans, 1992) although in the charcoal coppice plantations of Brazil the first coppice crop is not always the best. This diminution in productivity mostly arises from stump death and poorer stocking per hectare as well as from the physiological feature of coppice shoots exhibiting “mature” characteristics at an earlier stage when grown on an increasingly old root system. There has been little evidence to suggest that the practice of coppicing itself depresses site productivity.

**PRODUCTIVITY RESEARCH OVER THREE SUCCESSIVE ROTATIONS IN SWAZILAND**

Research in the Usutu Forest, Swaziland, began in 1968 as a direct consequence of

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**TABLE 1. Yield of second and third rotation *Pinus patula* at age 14 years, from 24 plots on Lochiel Hood granite or ancient gneiss complex soils (86 percent of the forest)**

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Stems per hectare</th>
<th>Mean height (m)</th>
<th>Basal area (m²/ha)</th>
<th>Volume (m³/ha)</th>
<th>Mean annual increment (m³/ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First: 1R</td>
<td>1266'</td>
<td>17.52</td>
<td>–</td>
<td>[297.4']</td>
<td>[21.2']</td>
</tr>
<tr>
<td>Second: 2R</td>
<td>1298</td>
<td>17.28</td>
<td>42.63</td>
<td>284.16</td>
<td>20.30</td>
</tr>
<tr>
<td>Third: 3R</td>
<td>1273</td>
<td>18.01</td>
<td>43.58</td>
<td>302.36</td>
<td>21.60</td>
</tr>
<tr>
<td>3R:2R (%)</td>
<td>-1.9</td>
<td>+4.2</td>
<td>+2.2</td>
<td>+6.4</td>
<td>+6.4</td>
</tr>
<tr>
<td>'t' statistic</td>
<td>–</td>
<td>2.94</td>
<td>1.28</td>
<td>1.89</td>
<td>–</td>
</tr>
<tr>
<td>Significance</td>
<td>–</td>
<td>P &lt;0.01</td>
<td>n.s.</td>
<td>P &lt;0.1</td>
<td>–</td>
</tr>
</tbody>
</table>

1 Unreliable figures thought to be slight overestimates. Source: Evans (1996).

**TABLE 2. Yield of second and third rotation *Pinus patula* at age 14 years, from ten plots in Forest Block A on Usushwana complex soils (13 percent of the forest)**

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Stems per hectare</th>
<th>Mean height (m)</th>
<th>Basal area (m²/ha)</th>
<th>Volume (m³/ha)</th>
<th>Mean annual increment (m³/ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First: 1R</td>
<td>1239'</td>
<td>18.18</td>
<td>–</td>
<td>[301.3']</td>
<td>[215']</td>
</tr>
<tr>
<td>Second: 2R</td>
<td>1170</td>
<td>17.03</td>
<td>37.57</td>
<td>248.22</td>
<td>17.73</td>
</tr>
<tr>
<td>Third: 3R</td>
<td>1025</td>
<td>16.87</td>
<td>38.93</td>
<td>255.12</td>
<td>18.22</td>
</tr>
<tr>
<td>3R:2R (%)</td>
<td>-8.8</td>
<td>-0.9</td>
<td>+3.6</td>
<td>+2.8</td>
<td>+2.8</td>
</tr>
<tr>
<td>'t' statistic</td>
<td>–</td>
<td>-0.26</td>
<td>0.55</td>
<td>0.18</td>
<td>–</td>
</tr>
<tr>
<td>Significance</td>
<td>–</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>–</td>
</tr>
</tbody>
</table>

1 Unreliable figures thought to be slight overestimates. Source: Evans (1996).
reports emanating from Australia about productivity decline in second rotation *Pinus radiata*. Since 1968 the productivity of each successive rotation of *P. patula* has been recorded using a network of sample plots throughout the Usutu Forest. Data from three complete rotations now exist and were reported recently by Evans (1996). The Swaziland yield records are arguably the best data set in the world for comparing three successive rotations of tree plantations on the same site.

The painstaking and carefully recorded measurements show that, for a large part of the forest (86 percent of the total area) where soils derive from a granite and gneiss complex lithology, there has been no decline in yield. Indeed, on these intermediate to slow weathering mineralogies (typically feldspars, biotite and muscovite) there is strong evidence that the third rotation is significantly superior to the second (Table 1). By contrast, in a small part of the forest (13 percent) dominated by gabbro-derived soils from the Uusushwana complex of slow to very slow weathering mineralogy (plagioclase, quartz and hornblende), a significant yield decline occurred between the first and second rotations but not between second and third rotations (Table 2).

Apart from the long-term nature of the research that has been maintained, an important feature of these data from Swaziland is that there has been no genetic improvement nor fertilizer addition from one rotation to the next. Moreover, the 1980s – especially the late 1980s – and the early 1990s have been particularly dry in this region, along with the rest of southern Africa (Hulme, 1996), but this has not affected the yield as might have been expected. The data are also important because the plantation silviculture carried out in the Usutu Forest over about 62 000 ha is intensive, with *P. patula* grown in monoculture without thinning and on a rotation of 15 to 17 years, which is close to the age of maximum mean annual increment. Large coupes are clear-felled and all timber suitable for pulpwood is extracted.

These plantations are managed as intensively as any example that can be found and, over three rotations, so far there is no evidence that the practices themselves are leading to yield decline as measured by crop productivity.

**THE FUTURE**

**The need for research**

Although the overview of the Swazi situation presents an encouraging picture, the serious lack of data recording yields in successive rotations is a major problem. It is not a new problem (Evans, 1984) but, at a time when all research budgets are being severely restricted, the maintenance of long-term records that are essential for answering the kind of questions discussed in this article will be increasingly difficult. This is all the more so in forestry research where rotations last from many years to many decades (Evans, 1994). Managers responsible for permanent sample plots must ensure that re-establishment is kept up in successive rotations and that data are recorded and stored for posterity.

The processes that impinge on site productivity are generally more widely researched. For example, the USDA Forest Service (Powers, 1991), the EU Level II Network under Europe’s Air Pollution regulations and the Centre for International Forestry Research (CIFOR) have established programmes aimed at creating networks of sites to gather data that record the impacts of plantation forestry practices (nutrient supply budgets, physical characteristics of soils, etc.). These networks will be an essential resource for scientific investigation in the future.

**Prognosis**

Genetic improvement of tree plantations remains largely in its infancy, with a few notable exceptions such as eucalypts growing at Aracruz, poplars and tropical and subtropical pines. It is clear that substantial yield improvement as well as other features such as disease resistance and better stem quality flow from tree-breeding programmes. With plantation forestry practice essentially appearing to be neutral regarding its impact on site productivity – the degree of soil improvement gained from trees is matched by the intermittent export of nutrients away from a site – genetic improvement of the crop should lead to some increase in yields in the future.

A less strong case, but still one leading to growth enhancement, is judicious fertilizer application. Certainly in Swaziland the limited area of forest where yield decline did occur between first and second rotations is being corrected by the application of phosphate on the essentially phosphate-poor soils. Such targeting of inputs to site needs will play a part in the maintenance of productivity, as in the case of magnesium (dolomitic limestone) in Germany. Allied to this amelioration of soil nutrition is the increasing realization that harvesting practices should minimize physical damage to a site and seek to conserve organic matter from one rotation to the next. Attention to weed control as part of good management must also continue.

**CONCLUSIONS**

Overall, it is reasonable to conclude that the outlook is positive and that, as a technology for producing timber efficiently, plantation forestry ought to be sustainable. Evidence from across the world suggests that plantation forestry is likely to be sustainable in terms of wood yield in most situations provided good practice is maintained. Improvements in


Freer-Smith, P.H. Do pollution-related forest declines threaten sustainability of forests? The evidence from European monitoring and research programmes. Ambio. (in press)


Criteria and indicators for sustainable temperate forest management – 1992 to 1996

C. Barthod

This article broadly outlines the procedures adopted by the Helsinki and Montreal Processes, as they concern sustainable forest management. The importance of cultural factors in identifying criteria and indicators for sustainable management is highlighted, together with related problems that have been identified but not yet fully solved.

The issue of criteria and indicators for sustainable forest management was brought into the political debate during preparations for the United Nations Conference on Environment and Development in 1992, when the Canadian delegation presented a proposal for guidelines on international cooperation and negotiations for development projects. The only trace left of this proposal in the Declaration of Forest Principles was a reference to “governing principles taking account of the relevant methodologies and criteria that have been internationally agreed, when they are judicious and applicable”. This minimal agreement did, however, pave the way for some major achievements: the Helsinki, Montreal and Tarapoto Processes and the mandate of the Intergovernmental Panel on Forests, not to mention the pioneering work of the International Tropical Timber Organization and the World Wide Fund for Nature.

FOUR MAJOR ISSUES REGARDING INDICATORS FOR SUSTAINABLE MANAGEMENT

The concept of criteria and indicators for sustainable management has various aspects – with consequent ambiguities – and this in part explains the amount of attention it receives. Four major issues are involved and they can be analysed separately.

1) At the national or provincial level where forestry policy is developed and actually implemented, criteria and indicators are tools for assessing the relevance and consistency of any action undertaken. No matter how sophisticated the instruments used in developing and implementing forestry projects, the contradictory results of public assessments in different countries over the past ten years have shown that an unquestioned reliance on technical expertise and a systematic chain of implementation are no guarantee against what turn out to be serious errors and glaring negative examples, nor against the unforeseen ill-effects that are part and parcel of any complex process. Most administrations now recognize that no forestry policy will automatically bear good results simply by following the procedures approved, but that constant reassessment (national, provincial or international) is needed on the basis of indicators covering a wide range of concerns.

2) Public opinion is increasingly concerned about forests, as they are seen as archetypal images of nature. Moreover, traditional approaches to policy-making and information on forests are no longer being accepted in democratic societies where participation and transparency in decision-making are considered a right as well as a guarantee that opposing views will be heard. Forests are not protected islands totally cut off from the workings of the rest of society, and foresters on their own cannot hope to grasp and control all the factors affecting their choices and goals. Criteria and indicators are first and foremost useful tools in setting up dialogue with all those who claim a voice in forestry policies and how they are implemented.

3) In countries where the state does not have direct overall charge of forests, forest owners or concession holders are subject to certain constraints, adapting the broad outlines of national forestry policy to local economic, environmental, legal and social contexts. There are two major approaches here: that of imposing the use of certain methods, instruments or procedures and that of specifying the objectives or obligations to be met. The former has traditionally been preferred, but there is growing support for the latter, based on

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Note: This article is an adaptation of a voluntary paper submitted to the Eleventh World Forestry Congress, 13-22 October 1997, Antalya, Turkey.
the assumption that local managers are in the best position to choose the most affective and cheapest methods, instruments or procedures once the public authorities have clearly defined the objectives. This use of decision-making criteria and indicators of results thus requires that norms be fixed for management units – a procedure not necessarily required for the two previous approaches.

4) To sway forest management according to their own analyses and priorities, some large environmental and consumer protection associations try to exert pressure on policy-makers or local managers by encouraging buyers to prefer products that are ecocertified over those that are merely tolerated or boycotted. An ecocertification procedure focuses on the quality of forest management and thus requires a prior definition of the criteria and indicators to be used as a basis for the guarantees that buyers are expected to demand. As with the previous point, this is basically a normative approach but it also raises the question of the choice and legitimacy of the structure that dictates these norms and gives credibility to ecocertification in the eyes of buyers. Theoretically, this normative approach can be applied equally well at the national or provincial levels where forestry policy is developed as at the management unit level. It can also be developed just as well in terms of methods, instruments and procedures as in terms of results.

In the context of issues 1 and 2, attention must be paid both to the absolute values of indicators and to the changes observed between two evaluations. Although absolute values are clearly important, they are largely dictated by the biogeographical context and the historical background to forestry policy; they flow from an observed situation in which the possibility of short-term (and often medium-term) action is bound to be limited, given the length of forest cycles and social resistance to any change. By contrast, changes are extremely important since they show the actual consequences of official goals, thus allowing a check on possible discrepancies between official pronouncements on forestry policy and its concrete outcome. Even when evaluation of a forestry policy or one of its aspects involves the examination of absolute values, this has to be done by referring to the objectives that the relevant government has freely set itself or that follow from negotiated and freely ratified international agreements. Although the importance of measuring changes is not forgotten in the framework of issues 3 and 4, the emphasis here is on absolute values, which are specified case by case and allow an evaluation of how closely a given instance of management is in line with a reference model, whether explicit or implicit.

The Helsinki and Tarapoto Processes, and to a large degree the Montreal Process, have very clearly chosen to emphasize issues 1 and 2, while the large international non-governmental organizations (NGOs) have devoted their energy to issues 3 and 4. This does not mean that various governments involved in these processes are not also very sensitive to issues 3 and 4 (even if it is only the major northern wood-exporting countries and countries where NGOs have a powerful influence), but at present there is no intergovernmental consensus to move in this direction, despite consultations and work within individual countries and the growing number of international and European Union work groups on ecocertification. Similarly, the large NGOs cannot ignore issues 1 and 2, although their strategic concerns and analyses mean that they will attack – and often very forcefully – the priority given them by various countries. Moreover, the lists of criteria and indicators developed in response to issues 1 and 2 on the national or provincial level are not necessarily relevant to issues 3 and 4.

STEPS NOW UNDER WAY AND THE LIMITATIONS OF THE EXERCISE

The identification of criteria and indicators is also a practical attempt to avoid the pitfalls of an overly theoretical approach that seeks to specify all the conditions for sustainable management in the abstract and to confine the provisional state of a technical-scientific and political-cultural consensus within a necessarily complex definition. The list of criteria and indicators adopted by the Helsinki and Montreal Processes reflects a compromise supported by both forest professionals and scientists. It encompasses indicators of both methods and results, since the very partial state of scientific knowledge means that we cannot yet do without the past centuries’ experience with different methods. The main aim of the selection process has been to adopt scientifically relevant indicators whose measurement is technically feasible and whose cost is not prohibitive. While results are admittedly imperfect, progress in scientific knowledge and instruments and the questions raised by public opinion should allow the present list, which is already long, to be further expanded and systematized.

Although the lists adopted by the Helsinki and Montreal Processes are rooted in very different contexts (the level of human intervention in forests, the structure of landholdings, the antiquity of forest laws and regulations, etc.), they are in fact fairly similar. They take account of: traditional biological parameters (area, volume, biological growth, forest type, etc.) as well as those raised by the 1980s debate on acid rain (health and vitality of
stands); traditional forest products (volume of felling and hunting) as well as aspects that have come to the fore in recent years (minor forest products, employment creation, participation in decisions on rural development); and the involvement of forestry both in general-interest protection missions that have long been recognized (soil and water) and in others that have developed more recently (biodiversity).

The current state of scientific knowledge and available inventories makes the concept of biodiversity a difficult one and means that indicators in this connection still require considerable refinement. Work on identifying species that indicate the healthy functioning of a given ecosystem is much more advanced for plants than animals, despite major North American reflection on the question. However, the main difference between the choices of the two processes hinges on the seventh criterion on the Montreal list — institutional aspects — which does not appear on the European list. These aspects have long been taken into account in forestry in countries adhering to the Helsinki Process, and they reflect a national and cultural balance in Europe where pragmatic considerations take precedence over the kind of theoretical consistency that countries with more recent institutional forestry traditions would perhaps tend to emphasize.

No list of criteria and indicators can be used to evaluate and conduct a forestry policy without a reliable and consistent mechanism to measure and evaluate the indicators adopted. A permanent or periodic forest inventory is indispensable, but there is also the question of indicators that fall outside the usual scope of traditional inventories. In some cases, forest inventories must be developed in order to take these into account in terms of measurement in the field, how statistics are treated during data processing and the use of new instruments such as geographical information systems. In other cases, however, it would be too expensive and inefficient to provide forestry services with sophisticated new measurement instruments, especially if there are highly qualified specialist services, which is often the case for monitoring water quality or animal biodiversity. This should encourage foresters to expand cooperation with services with which they have had very little contact in the past and, furthermore, it will develop a new awareness of the impact of other policies on forests. Such a choice develops new working methods, requires an understanding of possible lines of cooperation and means that this new situation will be taken into account in the relevant international processes, especially within the regional offices of FAO. It enabled France to publish a list of national indicators for sustainable management as early as April 1955.

Old forestry countries have sets of statistics going back a long way which provide a valuable record of methods and definitions. As always when new international concerns appear, there is much discussion focusing on the attempt to standardize definitions and inventory methods, despite the failure of numerous previous attempts. In the present context, it is essential that the publication of indicators should always give the source of figures and the methods of calculation used in the case of indirect estimates in order to provide a public guarantee of the reliability of the figures and sometimes to specify limitations to their interpretation. Standardization is in fact vital in only two specific cases: for those advocating a supranational forestry policy (for example in a union framework for member countries of the European Union); and for those seeking to establish a consistent international mechanism for eco-certification supervised by a central authority. In the first case, the solution would have to entail payment for a supranational inventory parallel to national inventories and allowing a sufficient period for the old set of data to be replaced. In the second case, a normative approach based on absolute values and with no standardization of definitions or inventory methods can very soon create difficult issues concerning equity between the countries involved – basically the wood-exporting countries – not to mention equity between exporting countries subject to examination and importing countries.

Defining criteria and indicators for sustainable management at the level of management units is particularly problematic when these units cover too small an area. Units in Canada are set at a lower limit of 500 ha, which would rule out three-quarters of the wooded area of France. Furthermore, in the interest of financial viability and efficiency, it is vital to fix the lowest possible number of indicators for managers to incorporate into their reasoning and decisions. Biological complexities and the “holistic” character expected of sustainable management make such a selection process particularly difficult. If a series of small, independent forest properties were grouped together and treated as a single management unit, this would clearly mean that owners’ rights would be subjected to the authority of biology experts, and most societies would be unwilling to accept this. It would also be unrealistic and politically foolish to consider insisting that certain goals must be met by hundreds of thousands (indeed millions, in France) of private owners of small forest plots whose main profession is in another activity. The only solution that would take this aspect into account entails a return to the obligation of using methods specified and monitored by the
of an international technocracy if such anything other than the fleeting consensus sustainable forest management could be hope that criteria and indicators for constraints.

scientific information and economic the imperfect control of available by the way a given society views it under governance both by biological reality and each forestry tradition, although it is both a science and an art, and these two aspects cannot be separated; expertise and knowledge based on sometimes centuries of experience play an important role in the approach adopted by each country and each forestry tradition, although it is not always clear how much comes from practical experience and how much is a result of cultural values and judgement systems. The way that public opinion and NGOs see forests is also influenced by a given society’s cultural values, concern over the future and relations with nature (albeit an imaginary rather than a real nature), and political decision-makers have to take this into account. It is thus inevitable that any articulated reflection or negotiations on criteria and indicators for sustainable management will be governed both by biological reality and by the way a given society views it under the imperfect control of available scientific information and economic constraints.

It would therefore seem pointless to hope that criteria and indicators for sustainable forest management could be anything other than the fleeting consensus of an international technocracy if such lists are jointly negotiated by countries that do not feel they have a common future, let alone a common cultural outlook, even if care has been taken to check that they have similar environmental, economic and social conditions as concerns the forestry sector. However desirable it may be, it is unrealistic to hope to negotiate a single worldwide list of indicators for sustainable forest management. On the other hand, it would be productive to encourage similar countries to join forces in order to draw up and implement such lists in the framework of open processes that allow each person or group (forest professionals, scientists and NGOs), whatever their country, to share its experiences and give public warnings against choices that do not pay adequate attention to available scientific knowledge and the common interest in assuming joint responsibility for the biosphere. Respect for the guidelines that would result from this would already represent considerable progress. Mutual recognition of these lists would in itself show the political intention of every country to move in the direction indicated in the Declaration of Forest Principles.

Unless this takes place, progress on criteria for sustainable management may indeed be made after long drawn-out technical and political negotiations, but such an agreement is not likely to go beyond a very limited group of traditional forestry indicators, unless the consequences of contemporary reflection on sustainable management are taken seriously. Another possibility would be to let scientists draw up such lists on their own, but this ignores the shortcomings of scientific knowledge in the forestry sector, the slow speed at which scientific consensus tends to be reached, the very uneven distribution of researchers in different parts of the world and the fact that scientists are not culturally neutral when asked to transform knowledge into expertise. The last possibility would be to leave economic forces free licence concerning ecocertification, letting buyers and sellers fight it out and letting donors impose their own criteria and indicators when negotiating the terms for development aid. In the case of many such solutions, it is clear that any instrument that might have helped the practical pursuit of progress in sustainable management would be robbed of its attraction for those concerned.

CULTURAL ASPECTS AND THE INTERNATIONAL DIMENSION

In democratic countries where public opinion exerts a strong influence on political decision-makers, experience during negotiations over these lists has shown the importance of the cultural elements involved in the wish to take both issues 1 and 2 into account. Forestry is both a science and an art, and these two aspects cannot be separated; expertise and knowledge based on sometimes centuries of experience play an important role in the approach adopted by each country and each forestry tradition, although it is not always clear how much comes from practical experience and how much is a result of cultural values and judgement systems. The way that public opinion and NGOs see forests is also influenced by a given society’s cultural values, concern over the future and relations with nature (albeit an imaginary rather than a real nature), and political decision-makers have to take this into account. It is thus inevitable that any articulated reflection or negotiations on criteria and indicators for sustainable management will be governed both by biological reality and by the way a given society views it under the imperfect control of available scientific information and economic constraints.

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CONCLUSION

An approach in terms of criteria and indicators for sustainable forest management offers such a good response to a whole series of negative developments in modern-day societies, including a wide variety of requirements, that it cannot be seen as a passing fashion in international forestry. Over the past four years, some exceptionally rich and stimulating work has produced solid gains, but has also raised many thorny questions that technical and political exponents are not yet in a position to solve. However, the development of forestry policies in many countries where forests play a major economic, environmental or social role will depend to a considerable extent on these answers. ♦

Unasylva 192, Vol. 49, 1998
Protecting Africa’s trees

S.T. Murphy

A review of the impact of pests on forestry and agroforestry in Africa, including current control actions and a proposal for a coordinated regional approach.

In sub-Saharan Africa, trees and forests are recognized by national governments and international development agencies as a key to the sustainable development and well-being of rural communities and the maintenance of the environment. Natural woodlands and forests, such as the miombo woodlands, the forests of the Eastern Arc Mountains of East Africa and the West African moist deciduous forests, are recognized as natural assets that are important to the preservation of biodiversity, and as a source of products (Miller and Adam, 1992). Industrial tree plantations, community/farm woodlots and tree-crop systems provide resources for sawntimber, pulp, fuel, fodder, shelterbelts and windbreaks. These planted stands contribute to the protection of the environment because they alleviate pressure on natural forest for wood products and because they play a crucial role in the prevention of soil erosion (Evans, 1992).

In response to the increasing recognition of the importance of trees, considerable progress is now being made in African national forest policy and its implementation. Over the last few decades there has been a particular emphasis on rural development forestry (community, social and farm) and agroforestry to meet specific land use objectives such as the reforestation of denuded land as well as the needs of local smallholder farmers (Burley and Wood, 1991; Wood in FAO, 1991). As a result of national policies, increasing amounts of land have been devoted to large- and small-scale tree plantations throughout the continent.

Unfortunately, many factors hinder some of the major objectives of forestry and agroforestry programmes. One particular factor that has become increasingly important over recent decades is the constraint and threat posed by pests: insects, nematodes, vertebrates, weeds and pathogens. For example, the Centre for International Forestry Research
(CIFOR, 1993) states that "... inherent weaknesses in forest protection management will severely compromise or even negate the value of research in other areas if tree growth and forest development are unduly affected by pests and diseases in an unquantifiable manner".

In this article we review the impact of pests on forestry and agroforestry programmes in Africa together with current actions to control some of these pests. We then discuss future priorities for tree pest management and propose a plan for a coordinated, regional approach to tree protection in Africa in support of national forestry and agroforestry programmes.

**PEST PROBLEMS AFFECTING TREES IN AFRICA**

In 1986, an alien sap-sucking aphid, the cypress aphid (*Cinara cupressi*), was reported from *Cupressus* plantations in Malawi. Feeding by the aphid caused dieback of branches and, frequently, the death of trees. By 1991 it had spread to eight countries in eastern and southern Africa and was estimated to have killed trees for a value of US$41 million, while continuing to cause a loss in annual growth increment of US$413.5 million per annum (Murphy, 1993).

The story of the cypress aphid exemplifies one of the problems affecting African trees today – the accidental introduction of exotic insect pests and diseases, which can affect both exotic and indigenous tree species. Native, African pest species rarely produce such spectacular results, but share with alien pests a capacity to reduce tree growth and fitness considerably through feeding and, consequently, a loss in annual growth increment. Finally, besides pests that directly affect tree health, invasive weed species can damage forests by competing with existing stands and preventing forest regeneration. In Africa, this problem is particularly serious today in programmes of conservation of natural forests for their biodiversity.

**Pest problems in general forestry and agroforestry**

Further to the cypress aphid problem, there are many other examples where a pest has severely affected an industrial or rural development forestry programme (Table). Many important trees have been affected, including species of *Pinus*, *Eucalyptus*, *Milicia* and *Khaya*. In agroforestry, the enormous effort and investment on the part of international and national research institutions to select agroforestry tree species and varieties that perform highly under African conditions can also be compromised by the introduction of a single unanticipated alien pest or the emergence of a native species as a pest.

For example, in the 1980s the leucaena psyllid (*Heteropsylla cubana*), which originates in Central America, spread across the Pacific and Asia, causing severe damage to *Leucaena* species. In 1992, the psyllid arrived in mainland Africa and is currently found in Burundi, Ethiopia, Kenya, Malawi, Mozambique, the United Republic of Tanzania, Uganda, Zambia and Zimbabwe, where it is causing severe damage to trees in smallholder plots and national research field trials. It is expected to spread to all *Leucaena*-growing areas of sub-Saharan Africa within the next few years.

Likewise, in the semi-arid lowland regions of eastern and southern Africa, the establishment of *Sesbania sesban* has either failed or substantial crop losses have been incurred because of the activities of root-knot nematodes. These nematodes feed on the root systems of

**Examples of where the use of a tree in a forestry or agroforestry programme has been severely constrained or threatened by a pest**

<table>
<thead>
<tr>
<th>Tree</th>
<th>Region or country</th>
<th>Pest</th>
<th>Stage of tree planting programme most affected</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wagner, Aduahene &amp; Cobbinah (1991)</td>
</tr>
<tr>
<td><em>Cupressus lusitanica</em></td>
<td>Eastern and southern Africa</td>
<td>Cypress aphid (<em>Cinara cupressi</em>)</td>
<td>Saplings/mature trees</td>
<td>Mills (1990)</td>
</tr>
<tr>
<td><em>Cupressus macrocarpa</em></td>
<td>Eastern Africa</td>
<td>Canker (<em>Rhychothopaenia cupressi</em>)</td>
<td>Saplings/mature trees</td>
<td>Gibson &amp; Jones (1977)</td>
</tr>
<tr>
<td><em>Eucalyptus</em> spp.</td>
<td>Eastern and southern Africa</td>
<td>Termites (<em>Macrotermes</em> sp., <em>Odontotermes</em> sp., <em>Microtermes</em> sp.)</td>
<td>Seedlings in nurseries/newly established plantations</td>
<td>CIFOR (1993)</td>
</tr>
<tr>
<td><em>Pinus radiata</em></td>
<td>Kenya, Tanzania</td>
<td>Needle blight (<em>Dothistroma pini</em>)</td>
<td>Saplings/mature trees</td>
<td>Gibson (1979)</td>
</tr>
</tbody>
</table>
S. sesban, causing the death or reduced growth of trees. Thus the investments that have been made in Leucaena sp. and S. sesban in Africa as solutions for smallholder farmer needs are now threatened.

Severe pest problems in tree-planting programmes have gradually become more frequent during the course of this century. The most important factors that have contributed to these pest problems are:

• the rapid increase in the area of tree plantations which has occurred over the past 30 years;
• the many plantations consisting of monocultures have enabled some pests to spread very rapidly;
• some plantations have been established on poor sites which has resulted in stress and reduced vigour and has made the trees more susceptible to pest attacks;
• most planting programmes involve exotic tree species and these trees run a high risk of attack by alien pests.
• In recent decades, national forest research institutes and forest departments worldwide have become more aware of the damage that pests can cause over time, even though the symptoms of this damage may not be readily apparent. Measuring the damage has been difficult but recent studies have shown that some pests can cause substantial losses in annual growth increment.

Pest problems in the conservation of indigenous forests

Alien pests such as the cypress aphid may have an impact on native tree species, but invasive weeds pose the greatest threat to native African forests today. Perennial weeds, for example Lantana camara and Chromolaena odorata, grow rapidly in clearings and can interfere with the regeneration of native forests in conservation areas. Particularly at risk are Africa’s continental and oceanic islands, with their highly endemic floras. On the African continent, the unique Eastern Usambara mountain range of Tanzania is under threat from alien vines and shrubs, including Clidemia hirta and Lantana camara, as well as from the introduced tree Maesopsis eminii (Hamilton, 1989). In Madagascar and the Mascarene Islands as well as the African islands of the Atlantic, invasive weeds have brought some indigenous tree species to the verge of extinction.

RECENT ACTION AGAINST ALIEN PESTS

In view of some countries’ urgent need for control of invasive alien pests, several pest management programmes have been started in recent years in different parts of the continent with technical support from CAB INTERNATIONAL (CABI), the Food and Agriculture Organization of the United Nations (FAO) and other international institutions. Most of these programmes have addressed not only specific pest problems, but also the need for institutional strengthening in tree pest management. Thus, in total, these programmes have provided a momentum and a foundation for a sustainable initiative in tree pest management for sub-Saharan Africa. Three representative efforts are now described. As these examples relate to exotic pests, biological methods of control feature strongly.

Cupressus and Juniperus

The cypress aphid problem was outlined earlier. At the end of 1990, the aphid was causing damage to exotic and native Cupressus and Juniperus trees in at least seven countries in eastern and southern Africa. In view of this, in 1991 a regional classical biological control programme was initiated with technical support from CABI. As a result, several countries have now established their own monitoring schemes and research programmes for the cypress aphid. Extensive surveys for exotic insect parasitoids have been conducted in Cupressus-growing regions of the northern temperate zone and, to date, two candidate agents have been identified. One of these agents is currently under trial release in Kenya, Malawi and Uganda. Some countries are complementing the biological control work with studies on host plant resistance.

Leucaena

The leucaena psyllid was also mentioned earlier. In Tanzania, the International Centre for Research in Agroforestry (ICRAF), in collaboration with a national programme, has initiated selection trials on Leucaena spp. and hybrids for resistance to leucaena psyllid attacks. They are also investigating the effects of
harvesting regimes on *Leucaena* spp. production and psyllid infestation levels. Further to this activity, a classical biological control programme is being undertaken in Tanzania and Kenya. In Tanzania, this programme is being integrated with the host plant resistance trials. Two complementary candidate insect parasitoids have already been identified for the leucaena psyllid from earlier survey work conducted for a programme in Asia, and these have been released in Kenya and Tanzania.

*Aza"dirachta indica*

*Aza"dirachta indica*, neem, is extensively grown throughout the Sahel region of West Africa and provides rural communities with vital supplies of building timber and fuelwood and it is equally important as a shade and shelterbelt tree. In 1990 widespread concern arose in West Africa from the "sudden" appearance of a disease that was subsequently labelled "neem decline". Investigations in the Niger and Nigeria by technical experts from FAO and the United States Agency for International Development (USAID) have been unable to identify any primary pest organism associated with this condition, a finding that would be an important diagnostic advance in calming fears about the spread of the disease. Furthermore, the establishment of monitoring plots by national programmes has already indicated that the condition may fluctuate annually in severity. One aim of the programmes is to distribute seed representing a more diverse genetic variation with a view to increasing the adaptability of the neem tree to local conditions.

Besides neem decline, the Oriental yellow scale (*Aonidiella orientalis*), which causes severe defoliation and sometimes death of neem, has spread throughout the region in the last ten years. All countries where the tree is planted are now badly affected. Damage by the scale is particularly bad where trees have already been affected by neem decline. In Nigeria, a programme of classical biological control and host plant resistance studies is now under way. A survey for exotic insect parasitoids is being undertaken by CABI in Pakistan, and potential biological control agents have now been identified. In Nigeria, surveys have begun to monitor populations of the scale and preparations are being made for parasitoid releases.

**FUTURE PRIORITIES FOR TREE PEDEST MANAGEMENT**

As a result of the initiatives discussed above and others, there is a new impetus behind tree protection in agroforestry systems and natural forests as well as in industrial and other plantations. To consolidate this development into a coherent set of needs and actions, CABI, the Kenya Forestry Research Institute (KEFRI) and FAO convened an International Consultative Meeting of Forestry Directors and Policy-Makers in Kenya in 1995 (Allard *et al.* in FAO, 1995). The countries that attended this meeting included Ethiopia, Kenya, South Africa, the Sudan, Tanzania and Uganda. At the meeting, the participating countries identified specific key problem areas (e.g. priority pests, information flow, policies for healthy forests) where national programmes need strengthening.

In general, the national programmes recommended that the problems should be addressed through a programme of institutional strengthening, training and regional cooperation, i.e. by networking pest management activities among countries.

The recommendations of the meeting are an important element of a vision for future pest management in tree protection in Africa. This vision, however, needs to be based on sustainable pest management strategies and the integration of these into planting programmes at an appropriate stage, although as far as possible these strategies should be preventive rather than reactive (CIFOR, 1993. The main focus of these strategies must be on overall forest health, whether it be the case of forest monocultures, polycultures or natural forests.

Overall, given that there is a continuum of land use systems involving trees in Africa, from pure monocultures through to mixtures of crops (including agricultural crops), pest management strategies need to have an integrated approach, i.e. utilize integrated pest management (IPM), which includes sustainable, low technology, environmentally sound and cost-effective components appropriate to particular land use systems and local conditions. Important components that should be considered in an integrated approach include pest monitoring schemes and biological control, which includes the conservation, augmentation or introduction of natural enemies, host plant resistance and silvicultural practices. Particular emphasis needs to be given to IPM strategies that prevent or reduce the risk of pest problems occurring. In this context, particular attention should be paid to practices such as correct site matching and the conservation of natural enemies. These factors must be considered before planting programmes begin. Further to this, the success of any IPM strategy depends on its careful implementation; thus IPM programmes should contain a significant training component for forest monitors and local farmers. ♦


Forest replacement schemes in Latin America: an effective model to achieve sustainability of supply for industrial fuelwood consumers

R. Carneiro de Miranda

A scheme for the operation and maintenance of self-owned reforestation projects associated with fuelwood production.

In theory, fuelwood may be obtained sustainably from managed natural forests, from wood waste generated by forest industry and logging or from fuelwood plantations. Natural forests harvested under a technical management plan are only viable in countries that have the political will and financial means to enforce them. Since these are not common conditions in many developing countries, and since it is a much more expensive way to produce fuelwood, this option is not normally feasible.

Wood waste from forest industry and logging are often freely available, since this material constitutes a disposal problem for industries and loggers. In developing countries, it is a common practice to burn waste in an open pit. This includes sawdust and other wood waste from saw mills and wood processing industries. Unfortunately, in most cases, the wood waste is not close to the fuelwood-consuming industries, nor is there enough wood waste to meet the total consumer demand.

Fuelwood plantations thus represent the best source of sustainably produced wood in situations where wood wastes or managed natural forests are not alternatives. Plantations are usually located on degraded or deforested lands, the fastest-growing category of land in developing countries. Given this most common scenario, why are there not more examples of fuelwood plantations in Latin America? Small industries such as bakeries, tobacco producers, lime producers or brick factories simply cannot afford to buy land or invest in a full forest operation.

AN OLD PROBLEM – A NEW APPROACH

In order to guarantee a constant and sustainably produced supply of fuelwood to the small- and medium-size consuming industries, a new approach is being implemented in Latin America. When the eastern coast of Brazil was colonized in the early 1500s, the Atlantic Forest, a dense tropical hardwood forest, covered most of the region. Colonists began extracting Brazil wood, the tree which gave its name to the country, because it was abundant and highly valued as the source of red dye. Brazil wood extraction was the first main economic activity of Brazil under Portuguese colonization. By the 1700s Brazil wood was becoming rare, and the remaining forest gave way to agriculture and settlements to extract the next main economic product of colonial Brazil, gold. Also during this
period, the Atlantic Forest gave up space to three of the world’s main agricultural commodities: sugar, cattle and coffee. Later in the 1900s, with the rapid industrialization of the region, the Atlantic Forest ceded its last major forest cover to allow the creation of urban areas, roads, industries, factories and agriculture for the more than 70 million people who live in the region.

Today, the Atlantic Forest is one of the most threatened ecosystems in the world, with only 8 percent of the original forest remaining. The other remaining forest cover in the region is in secondary (degraded) forests. Up to the 1980s, the fuelwood-consuming industries relied completely on secondary degraded forests, often having to pay high transport costs. In order to stop the unsustainable harvest of the secondary forests remaining in southeastern Brazil, new environmental legislation was introduced by some states in the 1980s. The legislation requires small- to medium-size fuelwood-consuming industries to form regional Forest Replacement Associations (FRAs).

**FOREST REPLACEMENT ASSOCIATIONS**

The Forest Replacement Association programme is based on a model that shares the costs of labour, land and capital equitably between consumer industries and resource-poor producers. Farmers traditionally are reluctant to invest in forestry activities because of the costs of the initial capital investment, and the length of time required for the return (usually five to ten years with fast-growing trees). To resolve this problem, many countries offer subsidies such as tax breaks and fiscal incentives. In the FRA model, the industry provides the initial capital but, since the farmers lack the land and labour, they are provided with incentives to participate. Basically, an FRA is a reforestation agent for wood-consuming industries that avoids the high capital costs of land and labour for the operation and maintenance of self-owned reforestation projects.

Each industry contributes monthly to a fund which is used to reforest the amount of wood (trees) consumed. For instance, if an industry consumes 100 m³ of fuelwood in a given month, it should reforest 600 trees since, in Brazil, approximately six fast-growing trees harvested at the age of six years will produce 1 m³ of fuelwood. The cost to reforest each tree is about US$0.25, including the seedling, technical assistance, fertilizer, wire, pesticides and administration.

With funds received from all fuelwood-consuming industries of the region, each FRA contracts forest technicians to promote reforestation among farmers from the area surrounding the industries. The trees are usually planted on small plots of land that are unproductive for agriculture but serve well for tree crops. Each farmer participating in the programme receives (free of charge) high-quality seedlings, technical assistance, fertilizers, protective wire and pesticides. The farmers agree to dedicate an agreed area to fuelwood plots; carry out the necessary maintenance to the trees; protect against insects, animals and diseases; plant 10 to 20 percent of the total area in trees with native fruits and wood species for conservation purposes; and grant first refusal rights to the industries associated with the FRA when it is time to sell the fuelwood.

At the time of harvest, industries that can prove that they are consuming the fuelwood produced by farmers enrolled in the programme receive the further incentive of a reduction equal to two-thirds of their contribution to the FRA fund. This provides incentives for the industries to consume the fuelwood from the plantations and guarantees a market for the participating farmers. The reduced but continuous contribution is needed to support and maintain the reforestation base for sustainable industry consumption.
WHY FRAs WORK
In Brazil, FRAs have been operating successfully for more than a decade. From 1985 to 1995, in the State of São Paulo alone, 13 FRAs were created and more than 20,000 ha of fuelwood plantations established, involving more than 3,000 farmers. Thousands of small industries in the State of São Paulo are currently consuming wood produced under FRAs. Recently, the states of Minas Gerais and Mato Grosso do Sul have also started adopting the FRA model.

What the FRA model does is to ensure a better distribution of the costs and profits of the fuelwood. In the developing world, there are several disincentives to reforestation and, besides the long period before returns are realized, farmers are usually paid a low price for fuelwood products.

In the FRA model, farmers avoid the capital cost of planting the trees and industry avoids the land and labour costs. Further, by reforesting closer to the consumer sources and trading through the FRA, the intermediary and transport costs are reduced. This decreases the final price of the fuelwood for the consumer industries and transfers better profits to the producers.

In the FRA model, farmers receive a guaranteed market with the consuming industries and a higher profit by trading directly through the FRA. Other benefits include increased production on formerly unused land, the protection of fragile soils and diversification of economic activities.

OTHER FOREST REPLACEMENT SCHEMES IN LATIN AMERICA

In southeastern Brazil, the big steel, cement and pulp industries that consume wood as charcoal, fuelwood and fibre are also implementing partnerships with farmers in the surrounding areas in order to reduce the costs of wood inputs. In a programme similar to FRA, called Forest Farmers, the capital provided by the industry is a loan, not a grant. On the signing of the contract between the industry and farmers, capital is provided in the form of inputs, equivalent to US$350/ha. This is then repaid in the form of “n” cubic meters of wood in the future, based on the market price on the signing date of the contract. In general, the farmer uses approximately 30 percent of the total wood production in order to pay back the loan. By giving first refusal rights to the financing industry, they can sell the extra wood produced at the actual market price. In the Forest Farmers programme, more than 100,000 ha have been contracted, benefiting about 1,000 farmers. This programme can generate a profit of approximately US$200/ha/year from land that is not usually productive under agricultural crops.

In Honduras there is another successful example of forest replacement in operation. In the late 1980s, fuelwood-consuming industries began experiencing shortages in local fuelwood supplies, together with associated increases in transport costs. Most of the industrial fuelwood available in the region comes from unsustainable harvest of the natural pine and hardwood forests in the surrounding mountains. Honduras is losing 80,000 ha of forest each year, with the overall forest cover having been reduced from 71 to 46 percent between 1965 and 1992. Fuelwood in Honduras accounts for 65 percent of the primary energy needs and 80 percent of all wood consumed, while more than 70 percent of the population relies on fuelwood as a source of cooking energy.
A cigar manufacturing company, Tabacalera Hondureña S.A. (TAHSA), has helped tobacco farmers of northern Honduras to reforest for fuelwood. Some tobacco growers need fuelwood to dry and cure the tobacco leaves. In 1989, TAHSA started a programme to promote fuelwood reforestation among the tobacco farmers in order to meet the industry’s needs for a constant and sustainable supply of fuelwood. TAHSA required all tobacco farmers using fuelwood for the curing of tobacco leaves to reforest 150 fast-growing trees per hectare of tobacco cultivated. TAHSA provides inputs (on loan terms) such as good-quality seedlings, technical assistance, fertilizers, pesticides and wire to protect the plantation against animals. At the time they sell the cured tobacco leaves to TAHSA, the farmers pay back the loan. TAHSA guarantees a market for the farmers’ tobacco, using it to manufacture cigars for the Honduran and export markets.

Initially, farmers did not like the imposition of TAHSA and asked why they should have to undertake the extra work of reforestation. But after 1994, when the first trees were harvested, farmers found that the cost of fuelwood in the tobacco curing process had decreased by 30 percent, mainly as a result of very low transport costs and better-quality fuelwood. Today, there are about 230 ha of eucalyptus in the northern region of Honduras, exclusively to sustain the tobacco farmers. Most of the farmers now support the programme and some are even planting much more than they need, looking ahead to a guaranteed fuelwood market in the near future as wood scarcity increases with deforestation.

**CONCLUSIONS**

Traditionally, the fuelwood sector has been informal, disorganized and inefficient. Governments have usually allowed natural forests to be a free source of fuelwood, largely as a result of their inaction. Traditional solutions have focused on giving farmers resources to plant trees for their own consumption. This has been largely unsuccessful, since small amounts of biomass are always available free of charge for family-level consumption in the rural areas. Moreover, the costs associated with providing farmers with materials and information needed to start their own plantations are high relative to the size of the plantations established.

The forest replacement concept, on the other hand, uses new and successful approaches: it holds commercial consumers responsible for the environmental impacts of their business (reversing the traditional business concept of privatizing profits and socializing costs); it reduces dependence on the public sector and foreign aid to finance reforestation; and it guarantees a commercial market and fair price for farmers.

The policy concept behind forest replacement can be used for any size of economy and could even be adapted to address commercial urban fuelwood demand, since there is profit behind it. For instance, in the capital of Honduras (Tegucigalpa), urban household consumers are paying more than US$20/tonne of fuelwood and, in Managua, the capital of Nicaragua, the prices have reached US$60/tonne, making fuelwood for cooking even more expensive than electricity and LPG.

Forest replacement policy so far has proved to be a win-win solution, since industry benefits from lower transport costs, law enforcement, better fuelwood quality, greater availability and closer vicinity. Farmers’ benefits are free or low-interest capital for reforestation, a guaranteed market at fair prices, diversification of economic activities and the use of low-productivity land. Finally, society benefits from the generation of jobs resulting from the injection of capital into the local forestry economy; reduced pressure on natural forests with conservation benefits; a shift to the private sector of the responsibility for environmental impacts incurred on a public good by industry; and increased national pride as a result of a decreasing dependency on foreign aid for reforestation purposes. ◆

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**Bibliography**


FAO Draft Forestry Strategy

FAO is currently preparing a Strategic Plan for Forestry, designed to give a coherent orientation to the Organization’s programmes in forestry over the next decade, a period in which the sector is expected to be facing increasingly complex challenges as well as promising opportunities.

Although the Forestry Department will have the lead responsibility for ensuring its implementation, the plan will embody the strategy of the entire Organization in the field of sustainable forestry development. The Strategic Plan, which will be revised periodically, looks ahead to the medium term (approximately five to ten years) and it will therefore be the basic document from which the implementation plans, i.e. FAO’s biennial programmes of work and budget, will be developed.

FAO takes a comprehensive view of forestry, which deals both with forests and with trees in different landscapes. Forestry is rightly concerned with the multiple economic, social and environmental benefits of forests as well. Activities are carried out not only in forests, but also on farms, rangelands, barren watersheds and in other ecosystems that are not traditionally considered forests. The commercial aspects of forestry address the many steps from production through to processing, marketing and trade. Since the future of forests is determined as much by developments outside as within the sector, FAO’s Strategic Plan for Forestry must look beyond the forest while the Forestry Department must work closely with other disciplines and agencies to ensure the optimal use and conservation of forests and associated lands. FAO also takes an inclusive view of forest stakeholders, supporting a variety of informal and formal organizations as potential partners in sustainable forest management. In defining a strategic plan, FAO thus seeks to meet the needs of its member countries and other clients, to foster interdisciplinary and multidisciplinary work and to facilitate collaboration with and among other organizations.

FAO itself does not manage forests and trees; rather, its role is to facilitate, catalyse and provide information, guidance and assistance for the actual managers of the resource. FAO’s primary clients are national governments representing member countries, but it also serves other concerned and responsible voices in forestry, including non-governmental organizations (NGOs), private companies, foundations, universities and rural people’s organizations. FAO seeks to assist these and other groups to achieve a better understanding, use and management of the world’s trees and forests. Through its own efforts and partnership with others, FAO aims to facilitate progress towards the sustainable management of all types of forest.

The draft Strategic Plan is currently being reviewed, both internally by the FAO Regional Forestry Commissions and externally. Individuals who wish to obtain a copy of the draft are requested to contact: Publications and Information Coordinator, Forestry Department, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy. Fax: (39 6) 570 53024; e-mail: fo-registry@fao.org

B.R. Sen Award to Hon Tat Tang - Forestry Project Coordinator

Hon Tat Tang, a Malaysian national with nearly 30 years of experience in forestry planning and research, has been awarded the prestigious B.R. Sen Award by the 29th Session of the FAO Conference for his outstanding contribution to the advancement forestry in Pacific Island countries. In 1990 Mr Tang was recruited by FAO as Project Coordinator to conclude the final 18 months of the South Pacific Forestry Development Programme (SPFDP), based in Vanuatu. Since his appointment, Mr Tang provided the leadership to rebuild the project into an important and effective focal point for the forests and trees sector in the Pacific Island countries. In October 1992, the United Nations Development Programme (UNDP) approved a four-year successor phase project, with new headquarters in Fiji, testament to Mr Tang’s leadership and commitment. The SPFDP has since developed into the main focal point for the forests and trees sector in the region today.

Given a limited operational budget, the SPFDP has achieved considerably more than would normally be expected, and programme partners appreciate and recognize it as the foundation of donor support in the region. The SPFDP has established an outstanding record of accomplishment and trust, and has consistently generated a high level of cooperation and collaboration among Pacific Island aid coordinators, heads of forestry and other government agencies, NGOs, UNDP, several bilateral donor agencies and the private sector. Under the leadership of the Mr Tang, the SPFDP has clearly illustrated how innovative networking modalities can operate and function effectively, given a flexible yet results-oriented approach to project implementation.

Mr Tang’s role in elevating the SPFDP to its present status was recognized by a 1994 Review Mission of SPFDP, which observed: “It was largely due to the personal style and networking ability of the Project Coordinator (Mr Tang) that the programme was so successful.
in obtaining collaboration from other agencies. He managed the programme efficiently and dynamically, and brought to it status and recognition. Most of the programme’s accomplishments are due directly to the current Project Coordinator, whose management style and networking abilities prompted the collaboration of numerous agencies throughout and beyond the region.”

The B.R. Sen Award, conferred annually by FAO, is named after a former Director-General of FAO, Dr Binay Ranjan Sen. The recipient of the award must have a minimum of two years’ continuous service in the field and must have made an outstanding contribution to the advancement of the country or countries to which he/she was assigned. This contribution must be clearly identifiable; it may take the form of technical innovations in agriculture, fisheries or forestry; institutional or development support improvements; discoveries of new resources as a result of surveys or other investigations; or the establishment of training and research institutions. The award carries with it a cash prize of US$5 000.

AFWC/EFC/NEFC Committee on Mediterranean Forestry Questions “Silva Mediterranea” holds 17th session

The 17th session of the AFWC/EFC/NEFC Committee on Mediterranean Forestry Questions “Silva Mediterranea” was held in Antalya, from 10 to 13 October 1997, as a satellite meeting to the Eleventh World Forestry Congress. The session was attended by delegates from 11 members of the Committee and by observers from four intergovernmental and international NGOs. The Committee deliberations focused on the following topics:

Activities of the Mediterranean Forest Action Programme (MED-FAP), 1994-1997

Various member countries involved in the programme outlined national progress in the implementation of their National Forestry Action Plans. Many of them, without international funding support, had established national committees and initiated a review of their forestry sector. Several countries presented accounts of recent developments in the forestry sector in their respective countries, following the guidelines of MED-FAP. Partnerships in the plans were discussed and the Committee concluded that consensus on procedures was more important than the final result. While international cooperation could be effective in helping to formulate the right questions, national characteristics and history were extremely important. Public participation in the planning and implementation of forestry programmes was also considered of vital importance.

The state of forestry in the region

Members reported on the state of forestry and related activities in their respective countries. The following issues were common to all reports:

• socio-economic aspects and people’s participation play an important role in the management of forest resources;
• environmental concerns are being addressed by different groups, and foresters have thus to interact with other professions in order to achieve optimal natural resource management;
• urban expansion into forests is a major concern;
• overall fire management (not only statistics) is a matter of concern to several countries;
• there is an expansion of forest plantations, especially on degraded lands, and of the use of recycled water for irrigation;
• the value of non-wood forest products and services is gaining ground;
• the importance of the services (e.g. ecotourism) provided by Mediterranean forests is increasing;
• there is a strong need for communication and coordination between forestry users and policy-makers.

The members present considered the role of Silva Mediterranea to be very important and unique and they expressed their unanimous support to the Committee, reiterating its role in the Mediterranean region. It recommended that
communication within the Committee itself be improved since efficiency was hindered by a lack of information exchange. It recommended that the secretariat should establish closer and proactive contacts and develop cooperation with other organizations with mandates and activities in the same fields of interest.

Activities of the research networks
The apparent weakness of the networks at present was felt to be due not to a lack of interest but mainly to the lack of communication, funds and the variable commitment of coordinators.

The Committee recommended that FAO should find ways and means to establish better cooperation between the research networks and the European Union, which is a member of the Committee, in order to seek its support for financial assistance, bearing in mind the problem of funding multilateral cooperation. It also suggested that, as many of the Mediterranean forestry problems were initiated outside the forestry sector, this aspect should be addressed by the research activities, for better coordination and synergies.

Assessment of the need for a new research network on the development of Mediterranean forest products and services
At its previous session, the Committee had recommended that the secretariat should study the need and possibility of establishing a new research network on the development of Mediterranean forest products and services. A final decision could not be reached. However, the Committee recommended that, bearing in mind the priorities of the activities of the research networks, cooperation with potential donors and partners such as the European Union should be sought in order to secure necessary funding. In addition, the Committee recommended that the secretariat should study the possibility of collaboration with NGOs, such as the International Association for Mediterranean Forests, for the exchange and diffusion of information.

International conventions (biodiversity, desertification control and climate change) in the Mediterranean context
It was recognized that the present structure and modus operandi of the Committee would not allow it to play a significant role in coordinating the implementation of these conventions. Nevertheless, within its mandate and means, the Committee agreed to endeavour to follow up on the implementation of the conventions and play an active role in collecting and disseminating information among member countries.

Scenarios for the future of Mediterranean forests
The Director of the Blue Plan (MAP/UNEP) presented information to the Committee on the trends of Mediterranean forests, which are under increasing pressure from demographic growth. The Blue Plan was undergoing a process of new prospective studies and was looking for expertise and dissemination possibilities for information that could be provided by the Committee. The Committee recommended that the Secretariat maintain active links and cooperate with the Blue Plan in this regard.

Silva Mediterranea jubilee
As the Committee would be celebrating its golden jubilee in 1998, it suggested that this event be taken into account when organizing the next session. It was recommended that a special paper commemorating this anniversary should be produced, summarizing the evolution and future prospects of Silva Mediterranea.
UN/ECE Timber Committee market statement

The 55th session of the United Nations Economic Commission for Europe Timber Committee was held at the United Nations headquarters in Geneva from 6 to 9 October 1997. Following is the official text of the market statement for 1997 and 1998.

Overview

In 1997, European forest products markets are recovering from the severe market conditions which prevailed in the first half of 1996. As forecast by the Committee in 1996, demand has strengthened, and production and consumption of nearly all products are expected to rise in 1997, compared with 1996.

Nevertheless, markets are still highly competitive, and prices for some products are still under pressure, partly owing to the globalization of markets. Overcapacity remains a problem for some sectors, notably for wood-based panels.

In North America, market conditions remained satisfactory, as consumption of forest products continued to rise, notably under the influence of a high level of housing starts.

Forest products markets in some transition countries began to feel the benefits of the successes of the transition reforms, leading to stronger domestic demand. For a few transition countries, forest products exports, notably of roundwood and of sawnwood, have made a major contribution to the national trade balance and have expanded significantly. Elsewhere, however, domestic demand is still very weak and the forest sector faces many grave problems.

The rate of economic growth varies widely between market economies. In the United States, the long-lasting economic expansion continued, at an annual rate of 3.6 percent in the second quarter of 1997, and continued growth is forecast for the rest of 1997 and for 1998, although at slightly lower rates. For the United Kingdom, second quarter GDP in 1997 is expected to be 3.4 percent higher than a year before. Output growth in 1998 is expected to be about 2.5 percent. The rise in the dollar exchange rate has given an export-led stimulus to the three major continental European economies (France, Germany and Italy), but domestic demand in these countries is rather weak and unemployment remains high. The German economy is expected to grow by 2.5 percent in 1997 and at about 2.5 percent to 3 percent in 1998, with rates of 2.3 percent and 2.8 percent for France. Italy forecasts growth below 1 percent for both years.

In all economies, measures are being taken to reduce budgetary imbalances, stimulated, for EU countries, by the Maastricht criteria. Everywhere, prices are rather stable. Unemployment, however, remains a major problem in many countries.

Housing construction has been stable, but at a high level in the United States (a rate of 1.45 million units in 1997), with particularly strong growth for prefabricated houses, which are major users of forest products. In Europe, however, residential construction is expected (by EUROCONSTRUCT) to fall by 1.1 percent in 1997, and not to grow in 1998. Repairs and maintenance are expected to grow by 2 percent in both years. There are however significant differences between national situations.

For the transition countries, the outlook for 1997 is quite uncertain, but also widely differentiated between countries. In the group of transition countries of northern and central Europe, growth well below 5 percent is expected in 1997, but in more southern and eastern countries the transition process is much less advanced, leading to stagnation or continued declines in output. The outlook for the Russian Federation is rather uncertain although, after a long period of economic contraction, the return of positive growth rates is expected.

While reviewing the forest sector as a whole, the Committee noted some structural developments. In particular, forest products are increasingly being reused, repaired or recycled into raw material or as a source of energy, thereby minimizing waste, energy consumption and use of landfill facilities, while providing an economic return to those involved. Used pallets and packaging and many types of demolition wood can be treated in this way. Taken together with the better known practices regarding waste paper recycling and the use of sawmill recycling as raw material, these developments mean that the forest sector is coming closer to a “closed cycle” situation, which would represent a major contribution to sustainable development.

In its special topic, the Committee examined “markets for certified forest products”, i.e. wood and wood products which can be identified as coming from forests which have been proven to be managed sustainably. While questions of forest management have received much attention, the effect of certification on the forest products markets has so far received relatively little emphasis. Based on expert presentations, national market statements and discussions, it was determined that, at present, the volumes of certified forest products available to consumers are extremely limited. In most cases, they do not command a price premium. However, certain niche markets are being developed by the pioneers in this field and certification of sustainable forest management may be a valuable marketing and public relations tool, for the producer or the retailer.
Empirical information on the motivations of consumers and retailers is only now becoming available, making it possible to carry out a more objective analysis of the situation. The Committee decided to continue monitoring markets for certified forest products at future sessions.

**Softwoods**

With improved construction demand, Europe’s sawn softwood consumption ended its two-year decline in 1996. It is forecast to rise by 4 percent in 1997 and remain at the same level, 75.9 million m$^3$, in 1998. In 1997, large advances in domestic apparent consumption are forecast in Sweden and Finland, both by 24 percent. Part of the explanation of this large rise is in stock changes: for instance, in Sweden, stocks are being built up to normal levels after a sharp decline in 1996. Germany forecast a 1 million m$^3$ increase in consumption to a record 16.6 million m$^3$. Correspondingly, European production is forecast to make the same increase to reach record levels of 78 million m$^3$ in 1997 and 1998.

Europe remains a net exporter of sawn softwood, notably owing to strengthening export markets in Asia. Both exports and imports are forecast to rise by 3 percent in 1997, to 30.7 and 28.5 million m$^3$, respectively, and then by 1 percent more in 1998. Most of the 2 million m$^3$ net exports is forecast to be exported to Japan in 1997.

The slump in sawnwood prices in Europe ended in mid-1996 and prices are rising in mid-1997 as stocks have been brought down. North American housing construction in 1997 is at a high level and it is forecast to drive sawn softwood consumption to a new record of 139.3 million m$^3$. With another increase of Canada’s housing starts expected in 1998, North American consumption of sawn softwood could rise by 2 percent more. Production is also forecast to rise by 5 percent in 1997 to 149.3 million m$^3$. In 1998, production would be near the 1987 high of 150 million m$^3$.

With housing starts forecast to fall slightly in the United States in 1997, to 1.45 million units, imports of sawn softwood appear to have peaked in 1996 at 43.8 million m$^3$. Imports are forecast to decrease in 1997 by 2 percent. Canadian exports to all markets are predicted to fall by 3 percent in 1997, to 48.1 million m$^3$, and then again more sharply, by 6 percent, in 1998. Partly making up for the drop in Canadian exports to Europe, as well as the drop from the Russian Federation, the Baltic countries, since their independence in 1991, have more than doubled production to 3.4 million m$^3$ and multiplied their exports to nearly 3 million m$^3$ in 1996. Resource limitations could hinder further expansion, despite the countries’ competitive advantages of relatively low labour and log costs, favourable foreign investment policies and a strategic geographic location of ports between the resource and the markets. These countries have begun importing logs and sawnwood from CIS countries for remanufacture and export.

In light of the continued deterioration of the economic situation in the Russian Federation’s forest and forest industries sector, consumption of sawnwood is forecast to fall by 14 percent in 1997 to 12.6 million m$^3$, but to recover the 1996 level in 1998. Production is currently constrained by a lack of domestic demand coupled with higher log prices. Production is forecast to decline by 11 percent in 1997 but rise by 12 percent in 1998.

Softwood log consumption in Europe is forecast to continue to expand, by 4 percent to 144.6 million m$^3$ in 1997 and by 1 percent more in 1998. Imports of logs from former USSR countries and within Europe continue to expand faster than exports. Imports of 12.1 million m$^3$ in 1998 are forecast to be about double exports.

In North America, the export of softwood logs continues to decline and is forecast to reach 10.1 million m$^3$ in 1998, less than half of the exports ten years ago. Russian softwood log exports are forecast to rise by 9 percent in 1997 and again similarly in 1998 to reach 7 million m$^3$. Some of these logs are exported to the Baltic countries as mentioned above, and Turkey and Hungary, as well as to Japan and the Republic of Korea.

**Hardwoods**

Europe’s sawn hardwood consumption appears to have ended its long-term decline and, in line with rising construction-related demand, is forecast to increase by 3 percent in 1997 and a further 2 percent in 1998 to reach 17.3 million m$^3$. Production is forecast to follow the same trend and reach 13.6 million m$^3$ in 1998. Sawnwood is competing with other forest products, both engineered wood products, including composite boards, and traditional wood products such as millwork, and with non-wood materials such as PVC plastic and metal. For example, in France the market share of wooden windows has fallen from 45 percent in 1989 to 32 percent in 1996.

Less than half of Europe’s imports, 1.9 million m$^3$, are forecast to be from tropical sources in 1997. Despite a continued decline in the volume of tropical timber imports into Europe, their gross value has increased as producers increase their value-added processing.

In North America, consumption of sawn hardwood is forecast to continue to climb slowly, by 2 to 3 percent in 1997 and 1998, to reach 29.1
millions m$^3$. Although still at a relatively low level compared with domestic consumption, exports are forecast to accelerate in 1997 by 15 percent and again in 1998 by 8 percent to reach 4.4 million m$^3$. Prices of sawnwood are increasing, especially for light coloured species. United States sawmills are investing in automation, expanding kiln drying and integrating, sometimes with foreign investment, into dimension production.

In the United States, the greatest volume of hardwood sawnwood, 10.6 million m$^3$ in 1996 of mostly the lowest qualities, was used for pallets and crating, which is one of the lowest-value uses. While pallet production is increasing, the use of recycled wood rose to 30 percent of the volume of finished pallets in 1995, double that of 1993, mainly owing to the recovery of wood in urban areas and its 50 percent lower cost. A growing share of pallets (11 percent in 1996) was repaired and recycled but 10 percent was still buried in landfills.

Hardwood log consumption and production in Europe are forecast to improve by 1 to 2 percent per year and to reach 31.9 million and 29.3 million m$^3$, respectively, in 1998. Trade of logs is at a low level and fairly steady. Exports of logs, forecast to reach 3.3 million m$^3$ in 1998, are half the volume of imports which continue to be increasingly from temperate sources.

In the United States, the consumption and production of hardwood logs is forecast to move up in parallel, by 4 percent in 1997 and by 2 percent in 1998. Exports are forecast to increase by 29 percent in 1997 and again by 18 percent in 1998, to 1.7 million m$^3$, half the level of European exports. Demand by foreign buyers in both Europe and North America has driven up log prices, sometimes to the disadvantage of local sawmills.

**Wood-based panels**

In Europe, consumption of wood-based panels (particle board, plywood and fibreboard) is forecast to drop slightly in 1997 by 0.7 percent to 41.5 million m$^3$ as the recovery in end use sectors has been timid at best. An increase of 1 percent is expected in 1998 to reach 41.9 million m$^3$. In general, markets remained depressed with prices under pressure and signs of overcapacity for particle board and MDF.

In North America, on the contrary, further expansions in consumption are expected in 1997 and 1998 of 2.9 percent and 1 percent, respectively, to reach 52.0 million m$^3$ as a result of the continued strong demand in the United States and the recovery of the Canadian economy in 1996 and first half of 1997.

Slight increases in consumption of particle board, the leading panel in Europe, are expected in 1997 and 1998 to 29 million m$^3$. In Germany, the main producer, production is expected to remain around 1996 levels, reflecting the weak demand in end use sectors. France, Poland and the United Kingdom expect major production increases. But markets for particle board remain very competitive and several less efficient mills have closed (three in Germany, one in Belgium and one in Portugal). Oriented strand board (OSB) is developing fast in Europe as the newly installed mills reach operational capacity and production is expected to increase by 60 percent in 1997 to 660 000 m$^3$.

Consumption of plywood in Europe is forecast to drop by 5.8 percent in 1997 to 6.7 million m$^3$ although a slight recovery is expected in 1998. Finland expects to increase production by 10 percent to nearly 1 million m$^3$ with 88 percent of this volume being exported.

MDF production now represents 70 percent of total fibreboard production in Europe. Exports of MDF outside the region mainly to Japan have eased the overcapacity created by the rapid expansion of the industry. Total fibreboard production is forecast to continue to rise in 1997 and 1998 by 2.2 percent and 1.9 percent, respectively; all the increase in MDF production is expected to go to exports outside the region.

In the United States, consumption of plywood is expected to drop by 5.1 percent and 3.7 percent in 1997 and 1998, 1.6 million m$^3$ in aggregate, as a result of softwood plywood mill closures owing to plywood substitution by OSB which is cheaper. The overcapacity in the structural panel sector has kept prices at low levels, and some older, less efficient OSB mills have also closed. In Canada, consumption is forecast to increase by 5.2 percent in 1997 with small changes in 1998.

Demand in North America for both particle board and OSB is estimated to continue to increase sharply in 1997 and 1998, in aggregate by 12.9 percent or 2.9 million m$^3$ to a total volume of 25.5 million m$^3$. Canadian production will benefit from continued increased exports to the United States, 12.6 percent in 1997 and 5.1 percent in 1998. A steep fall in prices was the result of the very rapid growth of the OSB industry, prices attained their lowest level in April 1997 at US$120 (per thousand square feet 7/16-inch basis). As announced OSB mills come on-stream, no new capacity expansions are expected.

Apparent consumption of fibreboard including MDF in North America is forecast to increase in 1997 by 5.4 percent to 7.9 million m$^3$ and a further 2.4 percent in 1998 to 8.1 million m$^3$. MDF capacity continues to expand, especially in Canada. Hardboard and insulating board consumption are expected to remain at 1996 levels.
Roundwood (pulpwood and fuelwood)

Supply and demand on the global pulp markets are better balanced in autumn 1997 than they were in the first half of 1996: stocks have fallen and prices have recovered (without approaching the 1995 record levels), partly owing to production cutbacks by some major producers.

As a consequence of the better conditions on the markets for pulp and for wood-based panels, European pulpwood consumption is expected to recover in 1997 and 1998 from the steep drop measured in 1996. By 1998, it is expected to have reached 186 million m$^3$, 14.6 million m$^3$ (8.5 percent) more than the low level of 1996 and about the same level as in 1995. Over the two years, Finnish pulpwood consumption is forecast to rise by 4.8 million m$^3$, to 41.6 million m$^3$, and Swedish consumption by 5.6 million m$^3$ to 40.7 million m$^3$. European pulpwood production is expected to recover marginally more slowly, by 4.4 percent and 1.9 percent, in 1997 and 1998, respectively.

Since 1991, European pulpwood exports have been dropping steadily, from nearly 20 million m$^3$ to 14.5 million m$^3$ in 1998. However, since 1993, imports, notably to Finland and Sweden which together account for 40 percent of Europe’s imports, have followed market fluctuations. In line with increased demand, European pulpwood imports are forecast to rise by 15 percent between 1996 and 1998, although they would then still be lower than in 1995.

Europe’s import requirements have in the main been supplied by the Baltic countries and the Russian Federation, which have all established regular trade channels to the Nordic countries. In 1998, pulpwood exports by the Baltic countries are expected to reach 5.5 million m$^3$ and by the Russian Federation, 10.7 million m$^3$.

Several delegations remarked on the increasing globalization of markets for wood raw material, notably pulpwood. Competition from low-cost wood sources exerts downward pressure on prices, putting economic pressures on forest owners.

Despite the expected higher levels of paper production, the United States expects a slight drop in pulpwood consumption, from 240 million m$^3$ in 1996 to 238 million m$^3$ in 1998, attributed to the increasing importance of recovered paper as a fibre source.

A number of countries reported an expansion in the use of wood for energy, in private households and in larger co-generation units. Often, these changes had been stimulated by official policy measures, designed to encourage renewable energy sources. Energy generation represents a significant outlet for low-quality wood, as well as being a contribution to the mitigation of climate change and, as such, should be encouraged as appropriate.

In accordance with the stronger demand conditions, European removals are forecast to rise over the two-year period, from 346 million to 362 million m$^3$, an increase of 16 million m$^3$, or 4.7 percent, with similar rates of growth for logs and pulpwood. Russian removals are forecast to fall from 94 million to 82 million m$^3$ in 1997, but to rise in 1998 to 92 million m$^3$ because of the many transition-linked problems. United States removals are expected to remain roughly constant at about 495-500 million m$^3$. ◆
Giving palms their due
The purpose of this study is to remedy this situation by providing basic information on palms as an important forest resource and to present a comprehensive coverage of the variety of non-wood forest products which can be obtained from them. Palm products are considered at both the subsistence and commercial levels, and particular attention is given to the potential for further development of some palm products. A geographic approach is employed to focus on palms in the different regions of the tropics. The prospective audience includes foresters, rural development workers and policy-makers, and international conservation and development agencies. Through the use of this document, it will be possible to assess better the contribution of palm products to sustain the livelihood of rural people and to evaluate the contribution of palms to sustainable forestry and agroforestry development.

Non-wood forest products: tropical palms was developed jointly by the FAO Regional Office for Asia and the Pacific and the Forest Products Division of the FAO Forestry Department at FAO headquarters. The draft of the document was prepared by Dennis V. Johnson, under the guidance of Patrick B. Durst and Paul Vantomme.

Updated ICRAF tree seed supplier directory
Tree seed suppliers directory: sources of seeds and microsymbionts. 1997. R. Kindt with S. Muasya, J. Kimotho and A. Waruhiu, Nairobi, ICRAF.
In 1991, the International Centre for Research in Agroforestry (ICRAF) published a directory of seeds and microsymbionts, Multipurpose trees and shrubs – sources of seeds and inoculants. The
objective of that directory was to provide users with contacts of potential seed or microsymbiont suppliers for agroforestry tree taxa and to provide a basis for selecting among those suppliers. Since then, new suppliers have come into being, and the directory needed updating. Therefore, in collaboration with FAO, the DANIDA Forest Seed Centre and the International Union of Forestry Research Organizations, and with funding from the British Department for International Development, the German Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung and the Flemish Office for Development Cooperation and Technical Assistance, ICRAF decided to review the suppliers and produce a new directory.

This directory is intended to contribute to the informed use of tree germplasm, which is an essential component of sustainable forestry and agroforestry practices, and promote wider use of quality germplasm. Quality has both a genetic and a physiological component, both of which are described in the directory.

The directory also highlights the importance of biosafety issues and presents biosafety information that suppliers have provided.

Although the directory focuses on tree taxa of importance in the tropics, it lists temperate taxa as well. It does not discriminate between taxa used for agroforestry and forestry. The purpose is to ensure that the information is useful to a wide range of users. Information from this directory is also available electronically on the Internet: (http://www.cigar.org/icraf).

Surveying long-term forest research plots in India

Long term research sites in tropical forests of India. 1996. S.N. Rai. New Delhi, UNESCO.

Frequently, much of the scientific investment in research does not reflect the use that is made of a specific undertaking and the information that can be drawn from it. An example is the long-term research plots that have been established in many parts of the humid tropics. Forest plots have been established but scientific and practical results have often not been commensurate with the time and money invested in them. India is perhaps the tropical country with the widest range of long-term forest plots, in terms of forest types and diverse environmental conditions. Some of these plots date back to the early part of the century, for example, in Karnataka State four stands of Hopea parviflora were established between 1911 and 1920.

This publication presents a review, synthesis and documentation of data on long-term forest research stands, undertaken through extensive travel within India and from records available in the State Forest Departments and in the Forest Research Institute at Dehra Dun. The study was undertaken with a view to describing the current ecological and management status of long-term ecological research stands in the tropical forests of India. The information generated through the study would be of high value for tropical forest research and conservation in India, and for the international community.

The study results from a meeting convened by the Center for International Forestry Research in Bogor, Indonesia, in 1993, and a presentation at that meeting by Dr S. N. Rai, Director of Forest Survey of India, Dehra Dun. The study was supported by UNESCO under a German Funds-in-Trust Project.

Two considerations of forest products certification


This volume presents an overview of the mechanics, background and implications of voluntary certification programmes. It features perspectives from all parties involved, from both Southern and Northern Hemispheres, including the forest products industry, indigenous communities, academics, biologists, certifiers, policymakers, environmental activists and retailers.

Among the topics considered are: the development of market-based conservation initiatives; elements involved in certification, from forest to retail...
product; biological aspects of forest auditing; implications of forest product certification; and the importance of the cooperation of all involved parties.

Certification of forest products traces the history of certification and the various certification programmes currently under way. It includes a valuable discussion and analysis of the social and political context in which certification must function.

Certified tropical timber and consumer behaviour. 1996. K.L. Brockmann, J. Hemmelskamp and O. Hohmeyer. Environmental and Resource Economics Series, Centre for European Economic Research. Heidelberg, Germany, Physica-Verlag. This study examines the impact of a certification scheme on German demand for tropical timber. As the focus is on the demand side, an already established, functioning certification scheme is taken as a starting point. By focusing attention on analysing the reaction of consumer demand, the study extends the scientific discussion of certification schemes for timber, which so far has been primarily concerned with questions of standards, feasibility and costs. The procedure adopted is to calculate different long-term scenarios (quality and price development) under various assumptions about the supply of sustainably produced tropical timber and the reaction of the German demand in response to a certification scheme.

The study is divided into three main parts: the first describes the general setting of a certification scheme and basic assumptions; the second qualitatively and quantitatively analyses the distribution and utilization trends for tropical timber in Germany, deriving basic scenarios for certification of timber in Germany; and the third part includes price effects and calculates extended scenarios with various assumptions regarding supply and demand.

The study concludes that a credible certification scheme could significantly expand demand for sustainably produced tropical timber in Germany, and suggests that such an approach could be valid for an OECD-wide programme as well.