

Forest Science Challenges and Contributions to Sustainable Human and Resource Development

By Robert C. Szaro, Atse M. Yapi, David Langor, Erich Schaitza, Kamis Awang and Karel Vancura

Introduction

Forests are global resources, and important issues dealing with their use and maintenance can not be effectively dealt with in an insular fashion. Global participation is mandatory if these resources are to be sustained and equitably utilized. Because of the many functions associated with forests, and the additional complexities of forestry when social and human dynamics are considered, what is truly needed for successful forest management and planning is a balanced approach. This approach must ensure that these resources will continue to exist at some acceptable levels for the benefit of current and future generations. This is often referred to as "sustainable forest management". It is quite complex, as it seeks to value the forest as a whole, treating all its functions as equally important. This is a challenging undertaking, but it also provides some opportunities to forestry research scientists and institutions.

A major challenge with sustainability is that it has many dimensions. A state of sustainable development is achieved only when progress made in one dimension does not compromise progress in any other dimension. For example, activities that enhance the productive function of forests should not reduce the protective capacity of the forests. To do this successfully, scientists need to adopt a multidisciplinary approach; that is, to work as a team of people from different disciplines relevant to the question on hand. This may not be easy to do, given that scientific activities in the forest sector have traditionally been disciplinary. Forestry research scientists and institutions must meet this challenge by reviewing the assumptions and research methodologies built into their strategic plans, and by revising the philosophies underlying these methodologies and assumptions. The greatest challenge limiting scientific contribution to sustainable forest management in many developing countries is certainly the lack of a critical mass of scientists within a given national research institution. National forestry research institutions may mitigate this constraint by networking with other such institutions and universities within and outside their individual countries.

Important concepts and questions for researchers are (Nielson 1999): What is forest and what is not? Who owns the forests? What is sustainability? In particular, the last question, concerning definition of sustainability, is currently vigorously debated in many international fora. But the focus seems to be on the wrong question, i.e., how do we develop criteria and indicators for sustainability? The relevant questions concerning sustainability are for what, for whom, and for how long? The focus should be on maintaining resource options for as long as possible for future generations. It is really simple and not rocket science. More forest is better than less forest. We need the most appropriate and not the highest technological solutions.

A focus on sustainability offers forest scientists and research institutions in developing countries the unique opportunity to make more effective use of their limited human resources. In most cases, local human capability at a high level is required, both with respect to knowledge of the field, which the technology deals with, but also in terms of analytical and decision-making skills. Improved research capability is crucial as research produces the scientific basis for the development of national science policy and, thereby, more informed international forest negotiations that can lead to improved global governance of forests. Successful integration of training programs, networking, technology transfer and information dissemination is needed to build significant research capacity. Moreover, improved linkages among policy-makers, stakeholders and scientific communities are required to make better use of research findings and to ensure that the research being done is relevant to their needs.

The capacity to achieve sustainability is highly variable and is positively correlated to the resources dedicated to forest research. Forest sustainability is therefore inextricably linked to development of the human resources needed to carry out this research and knowledge transfer. Yet, research is not a high priority for development aid, nor is it a high priority on the agendas of most developing countries. This can be attributed to three main factors:

- **Timeliness** – the typical research response to management questions is to ask for more time and more money
- **Relevance** – the results (i.e. information and/or knowledge) of most research is not provided in the forms needed to improve management or policy
- **Value or Impact** – the results of much research are not really incorporated until much later so the short-term view requiring immediate pay-back does not work well in the traditional model for research (Nair et al. 1995).

This calls for a new model for research, one that improves all three simultaneously. A model that:

- Recognizes uncertainties as an inherent part of all ecosystems and that we will never know it all
- Implements management as part of an experimental design
- Incorporates stakeholders at all stages in the research process and in the development of goals and objectives
- Monitors and evaluates progress towards these goals and objectives
- Adapts management based on this new information

There are three keys to making this a reality for sustainable forest management: **information, innovation, and implementation** – all derived from human resources. Consequently, we wish to focus on the importance of sustained human development in sustaining global forests, particularly in the developing regions of the world. To fully understand and appreciate these forest science challenges and contributions, it is useful to:

- establish an appropriate background against which the challenges and contributions should be viewed
- look at the current state of forest science in the African, Asian-Pacific, Latin American Regions and Eastern European Regions
- review the main forestry problems/challenges in each region
- highlight some forest scientific contributions from each region
- suggest how to improve our capability to deliver knowledge for a sustainable future.

The State of Forestry Research in the Developing World

The gap between developed and developing countries in forestry research capacity and the delivery of usable results remains unacceptably wide. Developing countries, with 80% of the World's population, account for only 2% of the global expenditures on scientific research and for an even smaller share of the research output, which is the quantity of direct importance. They continue to face difficulties participating in the globalization process and many risk being marginalized and effectively excluded from global dialogue. Poverty, hunger, malnutrition, and economic stagnation, including slow or negative economic growth, continue to hinder development. Within resource sectors, forestry and agriculture remain central to many economies but are critically deficient in equipment, infrastructure and research and development capacity (Szaro et al. 1998).

The reason for the low priority given to research in many developing countries is often not because of lack of perceived need for scientific research capacity, but rather that the returns of investments in research often are indirect and are visible only several years after the research capacity has been established. This makes it very difficult to assess the return on these investments and to incorporate their true value into accounting systems. However, highly efficient technologies, even low cost

technologies and technologies adapted for local use, tend to contain a large amount of research-based knowledge.

Most experts today agree that the state of forestry research in many developing regions of the world can be characterized as follows:

1. Political commitment to forestry research is lacking in most countries
2. Lack of a "critical mass" of scientists, with missing expertise in many areas; thus research tends to be fragmented and narrowly focused on a few traditional topics, e.g. agroforestry, pest management, biomass production, and silvicultural trials
3. Low "quality" of research, especially in the areas of methodological and technological innovation
4. Poor communication and transfer of research results in forms understandable by end users that can lead to the application of improved practices
5. Lack of a strategic planning of applied research programs
6. Inadequate funding of research programs
7. A tendency to duplicate research efforts and failure to capitalize on collaborative opportunities because of poor information sharing among institutions and scientists within countries and region
8. Research strategies are oftentimes "donor" driven and do not reflect regional or country level priorities.

As a result of these shortcomings, forestry research in many places has not evolved coherently at any significant degree and, thus has not been able to produce timely and relevant knowledge, information and technologies for current and foreseen global, national or local issues. If the current general situation remains, there will be continued inadequate contribution of science in these regions to the development of sustainable forestry. Although developing regions all share a basic underlying economic adversity, each region must be examined separately because the historical, cultural and political influences differ substantially between and among regions. In this way, one is best able to view the complexity of the forest research "landscape" in the developing world, understand its challenges, and appreciate the relevance of its contributions.

Africa

Background

In the 1960s, the newly independent nations of Africa thought they could rely on their natural resources and, in particular, on a vibrant forest-based

industrialization, which would help to build solid capital bases for economic development. Logging activities were intensified and many forest-based industries were established in most forested countries. However, by the 1980s, the great hope started to fade away. Today, it is evident that the forest industrialization efforts failed to produce the expected capital base, and there has been alarming deforestation and land degradation exacerbated by increasing rural poverty and large foreign debts. But, the role of forests and forest products as a strategic resource and a capital asset of high economic and social value for Africa, its economy and its people no longer needs to be demonstrated. Yet, throughout the region, forest sectors are consistently marginalized in public budget allocations as well as in private investment decisions.

One reason often cited for the marginalization of the forestry sector in government budget allocations is the lack of understanding by senior policy makers and planners of the broad range of benefits provided by forests and forest products to local communities and national and regional economies. For example, in a country like The Democratic Republic of Congo, where over four million rural dwellers and their families derive their livelihood from the forest, official statistics indicate that the forest sector contributes only one percent (1%) to Gross Domestic Product (GDP) (FAO 1996).

Another important reason for the marginalization, which is not so often cited, is the fact that African governments have traditionally neglected forests. Mujika (1994) illustrates this by the following reflection on the former Zaire: "Until recently, the forest sector was not the subject of a reasoned and coherent policy aimed at increasing its contribution to social and economic development. It was only in 1980, following the decline in the mining industry, that the State began to interest itself to the sector".

Forest sectors in Africa have been marginalized as well in private sector initiatives. Indeed, in the majority of countries, private forestry investments have been discouraged by factors such as (1) insecure land tenure systems, which do not guarantee that the fruits of a forestry investment will be there to be enjoyed privately by the investor; (2) the typical long delay until payoff associated with most forestry investments; and (3) the high risk associated with forest sector investments which are long term in nature (Yapi 1999a, 1999b). This risk factor is compounded in many cases with an environment of political insecurity and social unrest.

This marginalization of the forest sector has important implications for forestry research and institutional development in Africa. As these and other environmental problems strain most African countries, society is increasingly focusing on community forestry and the participation of local forest peoples and communities in caring for the forests. The international community and Non-Governmental Organizations (NGOs) are backing this new orientation, as evidenced by the declarations in favor of

forests everywhere in the "Agenda 21" and by the many International Conventions that cover various forest aspects in which many African nations are signatories. It is against this background that forest science challenges and contributions in Africa should be viewed.

Major Forest Science Challenges and Opportunities

The focus on local forest communities provides at least two major challenges to national forestry research organizations in Africa (Yapi 1999c). First, it questions the old research paradigm that forests are better cared for by the State (forests belong to the State anyway) and that government forestry objectives reflect as well the concerns and needs of forest peoples and communities. It therefore challenges national forestry research institutions to review their strategic plans so that concerns and needs of forest communities are properly accounted for. Second, this new orientation toward community forestry challenges researchers and their institutions to expand their research into identifying and meeting the needs of local peoples. This may require a new assessment of research philosophy, priorities and methodology. It will no longer be the case to do research for local people, but with them as partners. This ultimately requires research scientists to change their mentality and attitude toward rural peoples, whom they must accept as knowledgeable in their own way and as capable of making valid contributions to forestry research. The so-called "participatory" approach provides a sound methodological framework, which could help research scientists make progress in this new direction. National research institutions which could effectively anticipate these changes in the social environment, and meet the challenges they bring, will more likely enjoy continued success.

The focus on local forest communities also fosters potential opportunities for national forestry research institutions. First, it provides the opportunity for creative works in an area, which traditionally may not be covered by academic curricula. Scientists in disciplines such as socioeconomics, sociology, philosophy and geography, seem more likely to lead creative works in this area. But they must do so in collaboration with their counterparts in the "hard" sciences. Second, it opens a window of new sources of funding for forestry research scientists and institutions with the ability to develop and submit strong research projects to donors interested in the fate of forests, rural poverty alleviation and the empowerment of indigenous peoples.

Forest science challenges in Africa are many. To mention but a few of them, one may note:

- The urgent need of forest engineering knowledge in a context of sustainable development
- The hard fact of rapid population growth in Africa, with over 75% of the growing population are rural dwellers, whose livelihoods depend strongly on forests and forests resources. Ways to reduce this structu-

ral dependency, which exert tremendous pressure on forest resources, are desperately needed

- With population pressure, deforestation, desertification and agricultural development, forestry is now being pushed to marginal lands. There is now than ever a need for forest scientists to find and develop new tree species and populations that could do well on these harsh sites.

Highlights of Previous Forest Science Contributions

As mentioned earlier, the many constraints in Africa did not allow forestry research to evolve to any significant degree, nor produce timely and relevant knowledge, information and technologies. Nevertheless, in some few cases, individual projects and collaborative research have made encouraging scientific contributions, which clearly stand as indicators of a way forward and a hopeful future for forestry development in Africa. One can, for example, cite:

- The contribution of forestry research to the improvement of commercial forestry practices in Zimbabwe (Shumba et al. 1999)
- The "Iroko project" - a case study of Ghana, Cameroon and Côte d'Ivoire, illustrating successful research collaboration between national research institutions. This collaborative research has produced scientific information which help Côte d'Ivoire's Iroko plantation programme at SODEFOR
- The many success stories in moderating desertification/land degradation and forest fire control in Burkina Faso, Senegal and Mali
- The establishment of a number of important forestry research Networks (SAFORGEN, AFORNET, CORAF-Forestry network, etc.) which aid information sharing and lead to better strategic planning at both national and regional levels
- IUFRO-SPDC research capacity building efforts in the region have included: training workshops (research planning and management, strategic planning, and grant writing and proposal development); regional consultations on research needs and priorities (held in Zimbabwe and Ghana); strengthening of partnerships with FAO, AFORNET, AAS, IFS, and regional forestry networks; assisting scientists to attend technical conferences; and the establishment of a Deputy Coordinator for Africa (Yapi 1999a).

Asia and the Pacific

Background

Despite the significant economic progress made by countries in the Asia Pacific in the past, poverty and deprivation persists and the recent economic turmoil has worsened the situation (Awang 1999). Rural communities, especially those dwelling in forests and forest margins, derive a substantial part of their needs from forests. Some of the minority groups

are particularly dependent on forests for most of their subsistence needs. Although direct dependence on forests may decline in the long run, forests will continue to be an important source of livelihood for a large number of people in the foreseeable future. The effects of economic liberalization and globalization tend to be uneven and in situations where necessary and sufficient conditions for taking advantage of the emerging opportunities doesn't exist, income disparities and deprivation will increase. As a result of this increased pressure on natural resources there will come an intensification of resource use conflicts that accentuate land degradation and other attendant problems.

Several countries are reducing public sector outlay in research as a consequence of implementation of structural adjustment programs and fluctuation in currency values, with further reductions in public investment in research is to be anticipated. This will necessitate careful consideration of the research agenda and the organization of research (Enters et al. 1998). This will also compel many research organizations to commercialize research and focus on short term marketable outputs

This is being partially offset by increasing private sector investment in research primarily supported by large integrated forest products companies. Primarily research efforts by such enterprises are focused on short rotation industrial species (especially to produce high volume) and on processing technologies. Gaining competitive advantage is the main objectives of such research efforts, with little focus on environmental considerations.

Although sustainable forest management is a major theme of discussion at the policy and planning levels and there has been a proliferation of efforts to develop sustainable forest management criteria and indicators translation of these efforts into action has been insufficient resulting in continued decline and degradation of forest resources. Often efforts have been fragmented and have not taken into account the complexities and dynamics of the ecosystems in the context of changing social and economic environment. As most of the natural forests are set aside for biodiversity protection and other environmental benefits, increasingly most of the wood is expected to be produced from intensively managed plantations. Current measures to enhance plantation productivity are focussed on tree breeding and improvement and intensive management, relying on high dose of inputs. Long term sustainability issues relating to forest plantations have not been adequately understood.

The priorities and organization of research are expected to be very different in the future than what they are now. Making forestry research relevant to the needs of the 21st century requires a clear assessment of the emerging needs and developing appropriate structures that are efficient, effective and responsive to the changing needs.

Major Forest Science Challenges and Opportunities

The dilemma facing almost all governments in Asia and the Pacific is that the global community is calling for greater conservation of forests while the majority of their people are demanding more forest exploitation (Asia-Pacific Forestry Commission 1998). Concerns for the protection of the local environment, for subsistence use of non-wood forest products, or for global issues like biodiversity conservation and combating climate change, are being felt across all countries in the region. Forest science in the region is faced with developing possible solutions to these many fundamental challenges resulting from rapid population growth, deforestation, and expansion of desertification (Lee 1999). To mention but a few of them, one may note:

- Growing populations are seeking both food security and a sustained wood supply for domestic and industrial needs. New approaches to agroforestry in the cultivation of multi-purpose tree species and using elements of intercropping will help to meet these needs (Khosla 1999)
- Estimates indicate that at least 3.4 million hectares should be reforested every year in Asia (Lee 1999). Rehabilitation of the degraded lands require integrated approaches based on a thorough understanding of the role of different components, including trees, in the farming system (Awang 1999). This will require the development of the key technologies and techniques needed for this extensive reforestation effort
- As most of the natural forests are set aside for biodiversity protection and other environmental benefits, increasingly most of the wood is expected to be produced from intensively managed plantations. Current measures to enhance plantation productivity are focussed on tree breeding and improvement and intensive management, relying on high dose of inputs. Long term sustainability issues relating to forest plantations have not been adequately understood (Awang 1999)
- One of the biggest challenges related to forest sustainability will be to achieve public awareness and acceptance that services are as important as timber benefits and that they can be economically realized (Asia-Pacific Forestry Commission 1998). Research on the valuation of such services and benefits and how to incorporate them into traditional accounting systems is vital in this regard
- The use of wood and wood products will continue to increase into the next century. In order to meet these needs, it is essential to develop affordable ways to use non-wood and non-forest raw materials as complementary sources of wood and fiber, to increase the efficiency in the conversion of raw material into finished products and to identify effective incentives to push forestry development in desirable directions (Asia-Pacific Forestry Commission 1998)
- Conservation of biodiversity and protection of the environmental values in conjunction with improving the livelihood of forest-dependent people would require strengthening of research efforts, firstly to understand the complex interactions and secondly to develop appropriate

systems, techniques and tools for forest resource management (Awang 1999)

- Most of the R&D efforts in biotechnology and allied areas are expected to take place in developed country institutions and in a limited number of well-established institutions in the developing countries (Salleh 1999). For most countries taking advantage of the developments will depend on access to information and the ability to discern what is relevant and what is not (Awang 1999)
- Increasing intensification of use of forest and external influences from global environmental change oftentimes result in concern for the maintenance of forest health. Information is needed on how to monitor and predict impacts of forest pests, apply integrated pest management, monitor and control forest fires, and determine the influences of acid-rain on forests and possible preventive techniques (Hong 1999).

Highlights of Previous Forest Science Contributions

Forestry research in the Asia-Pacific has been particularly strong. Indicators of previous contributions include:

- One of the areas where considerable progress is being made is through collaboration in transferring research and technology. Both IUFRO and FORSPA (FAO Project, Bangkok) have tried to assist and consolidate the gains from forest research networking. The recently established Asia Pacific Association of Forest Research institutions will increasingly serve this objective in the future (Asia-Pacific Forestry Commission 1998)
- In 1991, IUFRO-SPDC began the BIOTechnology Assisted REFORestation Project (BIO-REFOR) based on the generous financial support of the Japanese Ministry of Foreign Affairs and strong technical support of IUFRO-JAPAN. This workshop series has focused on propagation techniques, soil conditions and mycorrhizae, and ecological processes in forest rehabilitation. Each year the project has continued to show substantial progress towards the overall objective of establishing the techniques needed to rehabilitate degraded forest-lands in the Asia-Pacific region
- During the past 50 years in China, over 4600 items of forestry research have been singled out for their achievements and contributions to forestry (Hong 1999).

Latin America and the Caribbean

Background

In 1995, Latin America and the Caribbean contained the largest natural forest area in the world with over 950 million ha, most of it covered by tropical forests with a complex biodiversity. On the other hand, the region is ranked second, after Africa, in the amount of deforestation for the period of 1980-1995, with a loss of 10.5% of its forests (FAO 1999). In

particular, the immensity of the Amazonian Forest and its high deforestation rate has brought global attention. This led in no small measure to the initiation of international efforts and conventions to address deforestation and related issues such as biodiversity and climate change. As a result of heightened environmental awareness, international donors have limited their support to projects that could lead to deforestation. Nevertheless, deforestation has not decreased as large economic development projects involving resettlement and expansion of agriculture frontiers continues to encroach on the forests of the Amazon Basin without much consideration of environmental impacts (FAO 1996). The problem of rampant human-caused deforestation has been recently compounded by the large increase in forest fires in the region due to long dry periods caused by El Niño and La Niña and the use of fire in agriculture.

Ownership of natural forests varies from country to country. However, irrespective of ownership, forest management in most countries is strongly regulated by law. Unfortunately, due to lack of political will and inadequate resources, enforcement is rare. In a similar irony, although very detailed management plans are required before intervention in private forests and concessions to public forests, they are seldom read or implemented.

Although political stability has improved greatly throughout the region in recent years, there has not been a corresponding economic improvement. High levels of unemployment, inflation and migration of farmers to large cities are problems common to most countries. The widespread economic stagnation has also affected the forest sector, which could be classified as an underachiever.

Industries that utilize tropical wood generally are of low technology and labor intensive. Log exports are not important in the region, representing only 0.6% of log production. Despite containing the largest tropical forest area in the world, the region accounts for only 9% of the total tropical timber exports by the International Tropical Timber Organization in 1997. Nevertheless, the region has increased its participation in the international market in the last decade (Johnson & Castaño, 1998).

Industries that utilize exotic trees are generally doing well. Plantations of fast-growing eucalypts and pines supplies a large industry in Argentina, Brazil and Chile, and is growing in importance in Uruguay. Plantation forestry is done in the most developed areas of the region where natural forests remnants cannot supply industries due to previous deforestation and high-grading. Industries that supply lumber, pulp, paper and panels supply the domestic markets and provide considerable exports to many regions of the world.

There is a good number of well-organized forest research institute and forestry faculties in the region, especially in countries with more tradition in forestry, such as Chile, Argentina, Brazil, Colombia, Mexico and Peru.

CIAT and CATIE, two CGIAR centers, contribute to the development of forest research in the tropical area. Large, organized forest companies contribute to forest research in many countries. On the other hand, various countries do not have any forestry research organization and sometimes no specific public structure to deal with forestry.

Despite the numerous current difficulties and shortcomings, the region has enormous potential to play a leadership role in the area of forestry and forest products. The large forested areas of the region should be a major source to meet the world's forest products needs in the next century. Forest research is an important tool to guarantee that the region becomes a sustainable player in the global context (Latin American and Caribbean Forestry Commission 1999).

Major Forest Science Challenges and Opportunities

The first challenge to regional research organizations is the organization of information systems. Papers published by Latin-American and Caribbean researchers are not always incorporated in international databases and information systems, and sometimes are not even registered in databases of their own institutes. With the lack of access, these papers are not read, appreciated and cited by other researchers. This sometimes leads to duplication of research efforts and inefficient use of research resources, and slows the progress of forestry science in the region. This situation may be attributed to several different factors: with few exceptions, local journals have a low circulation, and their editors do not send copies to AGRIS institutes or CABI; some AGRIS institutes are not very active in forestry area; there is a large number of non-indexed publications; libraries are passive structures waiting for people who borrow books; articles published in Portuguese or Spanish are not read by English speaking scientists; Latin-American information systems are poorly equipped to keep pace with European and North American counterparts. Therefore, there is a need to better organize information systems to effectively facilitate dissemination of bibliographic references and full papers throughout Latin America and the world. This requires strengthening of libraries and institutional information systems and creation of small thematic networks oriented to the organization and dissemination of information on specific subjects.

The deforestation of regional tropical forests will continue if science and technology does not provide knowledge and tools to ensure that forests become profitable resources, especially in small scale businesses or farms. This requires new sustainable production systems, collaboration with land owners and communities to develop agroforestry systems, enhanced appreciation and utilization of non-timber products and local processing of products in small efficient factories. Furthermore, research focused on creating viability in small-scale forest operations and utilization of non-timber forest products is a way of mitigating unemployment and poverty, two of the most fundamental problems in the region.

Other forest science challenges for the Latin American and the Caribbean region are numerous and various. These were articulated and discussed by regional scientists in 1996 at a consultative forum organized by CI-FOR and Embrapa, and the following items were listed as key opportunities for cooperative research (Sabogal 1996):

- research on forest policy related to sensitive questions, such as land and resource ownership, incentives and controls affecting the forest sector, and forest fires
- the role of the private sector in forest management and industrialization
- forest management at landscape level
- use of lesser-known species
- plantations for energy production
- industrialization and marketing of forest products
- creation of forest germplasm and seed banks
- valuation of assets and services of forests; future sales, global compensation schemes
- social and cultural aspects of forest management in natural forests and plantations
- gender and indigenous group relations
- long term impacts of forest plantations
- cost - benefit analysis of research
- support to investigation through better education, networking, documentation of experiences etc.

Highlights of Previous Forest Science Contribution

Forest research organizations in Latin America and the Caribbean mirror the situation in their respective countries or regions – financial hardship and antiquated facilities. There are some exceptions, such as Chilean Universities and a few institutes or universities in other countries. The opportunity to travel to developed countries contributed to the education of a good number of scientists and technicians who are now teaching at universities or conducting research in public and private organizations. Some examples of activities which have been successful with support of forest research:

- integrated pest management of pine and eucalyptus pests in the Southern Cone, with networking of research and quarantine structures;
- advances in breeding and silviculture of eucalypts in Brazil and of radiata pine in Chile;
- the industrialization of eucalypts and pines in the Southern Cone;
- the Madrileña project in Central America and the Caribbean, which promotes the appropriate introduction of tree species for fire wood production;

- studies of sustainable forest management in the Amazon Basin;
- the emergence of eco-tourism as a major industry in Costa Rica;
- the existence of a number of universities with M.Sc. and PhD graduate courses;
- hosting of the Primer Congreso Latinoamericano IUFRO in 1998 which brought together forest scientists from all disciplines throughout the region to share advancements in science and policy.

Central and Eastern Europe

Background

Over the last decade, many nations in Central and Eastern Europe (CEE) have experienced a profound transformation or transition of their economies, from the central planning approach of communist regimes to a market-oriented approach (Vancura 1999). These changes are not only economic, but also encompass the political and social spectrum. The transition continues to have substantial impact on virtually all aspects of life in these nations, including forestry. In the 1990's, the ownership of forested land experienced a dramatic shift in most of these "countries in transition" (CINT). The trend towards nationalization and central planning experienced in the wake of World War II has been largely reversed, tending towards privatization, reduction of state influence, and a shift towards a market economy and pluralism. The goal of this economic liberalization was to stimulate economic growth and improve standards of living. Although these goals are still realistic, and there are some tangible improvements, the overall transition continues to cause substantial economic hardship.

With the ongoing transition process, the forestry institutions of most CINT are now engaged in crisis management (FAO 1997). Previous to the transition, forestry research institutions were an integral part of the central planning regimen and were almost exclusively funded by state resources. Consequently, research efforts were focused largely on attaining central political and economic objectives. In the wake of political and economic reforms, federal funding for forestry has steadily declined, and has not been supplemented with any substantial resource inputs from other sources. Personnel in forestry institutions have diminished due to decreased funding and inadequate salaries, and many of those remaining have supplemental occupations and so are not fully focused on forestry research. Consequently, forest research has suffered. Under-funded and under-staffed institutions have been unable to maintain ongoing medium- and long-term projects initiated before funding cut-backs. Also, in times of hardship, institutions and people tend to fall back on what they know and do best. Thus, ongoing research tends to be largely entrenched in classical scientific and technical topics that were the focus of attention and expertise during the previous era. As a result, research is not evolving to meet new social and economic needs emerging from ongoing in-

dustry privatization. The problems are compounded by the fact that management of institutions has adapted slowly to the new economic environment, and the functioning of these institutions is problematic. Research now needs to be marketed and sold, and short-term economic impacts must be considered, in spite of the fact that forest management goals are generally long term. Furthermore, forestry institutions, not only those focused on research, must now face increasing competition from national and international sources, and considerable effort must be made to solicit resources from the consumers of research. However, currently new forest owners (mostly small ones) have many problems of their own and are not very interested in funding research activities.

Political liberalization and democratization in CINT and the near-simultaneous United Nations Conference on Environment and Development (UNCED) has resulted in greatly increased public participation in forestry issues. Government administrations, including the state authorities for forestry, must now consider the viewpoints of national and international non-governmental organizations (NGO) in the decision-making process. The relatively restricted and closed community of forestry professionals and traditionally conservative society must now open up to wider public discussion. Overall, the public is demanding more information and a greater role in decision-making in forestry. Furthermore, the increasing and oftentimes substantial private forest ownership is also forcing more openness in the forestry sector. The private forestry sector and NGOs should perform a valuable watchdog role as they scrutinize the actions of state forestry administrations.

Changes in CINT have necessitated revision of policy and legal frameworks in all sectors. In particular, UNCED and subsequent follow-up activities, have led to a new awareness and activism in environmental protection, which has had a direct impact on forestry. Almost all CINT have formulated new forest laws in the past 7 years which deal mainly with management regulations for state and private forest ownership (FAO 1997). Embedded in the legal instruments is a recognition that forest sustainability encompasses the entire ecosystem and its myriad values and functions. Thus, environmental protection is receiving more attention and the forest management 'pendulum' is swinging slowly away from a solely fiber-focused strategy to that which is more holistic and incorporates ecological, social and economic values. This globally accepted strategy and new evolving forest management paradigm presents many challenges and opportunities for forest science.

Major Forest Science Challenges and Opportunities

Forestry of CINT is mostly based on classical approaches, which were largely created and developed in this part of Europe. Following World War II drastic changes in the political landscape had far-reaching consequences for forestry, and generally did not bode well for forestry research, management, extension, and education. The environmentally irresponsible policies of the direct communist resulted in serious weakening

of the ecological stability of forest ecosystems. Furthermore, the nearly total isolation and limitation of foresters and forest scientists in CINT resulted in limited exchange of results, ideas, and innovations with the western world, greatly limiting opportunities for science and technological advancement. However, the recent political changes provided new possibilities for international contacts, resulting in active participation in joint programs and projects, access to latest results and ideas via direct exchange of information through personal contacts, and access to new technologies. Thus, foresters and scientists in CINT are now faced with the task of absorbing, assessing, adapting and applying a great deal of newly-available science and technological information to help achieve new forest management goals. However, it is important that foresters and scientists preserve and build on the good achievements of the past, while trying to incorporate new ideas and approaches, and to balance long-term goals with short term interests. The signing, by almost all CINT, of the protocols and resolutions of several recent international environmental conventions (CBD, FCCC, Desertification), many of whose elements deal with forests and their protection, now commits these countries to international obligations which must be satisfied despite the existence of many fundamental problems and challenges. Some of the major forest science challenges faced by CINT are (FAO 1997):

- The processes of compensation, restitution and privatization have created very large numbers of private forest owners, many with small holdings and little background in forest management. Thus, the wealth of traditional forest management techniques developed for the previous large government-controlled forests must be assessed for their appropriateness for small private owners. Adaptation of these techniques, and the development of new ones, may be required. This demands an integrated approach involving research, policy and extension, and real collaboration between government, stakeholders, scientists and foresters
- New private forest owners may have a range of objectives for their forested lands. These may be social, recreational, environmental, or harvesting. An inventory of forest-owner management objectives is needed for overall analyses of how the forested landscape is partitioned among the different management goals, and for integration of local objectives into a more holistic plan to meet national needs and adhere to international commitments. Involvement of private forest land owners must be brought into the definition of forest research tasks (Paule 1999)
- Many forested lands have been degraded due to poor management (e.g., planting with inappropriate tree species) and effects of pollution. Thus, research efforts directed at ecological and economic reconstruction of degraded lands is required
- The rapid changes in the nature of forest planning and ownership in CINT demands a new approach to analyses of social and economic aspects of forest management, a discipline that was largely stifled under

the earlier central planning regimes. Furthermore, the commitment to sustainability requires a sound ability to assess social values

- New forest legislation in CINT has generally embraced the concept and goal of sustainability of forested ecosystems. This necessitates that science and research play a central role in selection and monitoring processes concerning criteria and indicators of sustainability
- Until recently, the relative isolation of the forest research and technology communities in CINT have greatly limited information exchange and networking with western. Consequently, there is a general need and desire to participate more fully in regional and global networks in the areas of science, technology and policy.

Highlights of Previous Forest Science Contributions

The nations of CEE have a long and well-recognized history and tradition in forest science, and were among those who created forestry as a science in the past century. Forestry laws and management plans resulting from this knowledge were known in Central Europe since the mid 18th century. Contributions include:

- Forestry scientists in the area between Eberswalde (Germany), Vienna (Austria) and Banska Stiavnica (Slovakia) founded IUFRO in 1892
- For more than 100 years, forest scientists of CINT have contributed significantly to the basic knowledge of forests, especially elucidation of the conditions and processes that influence and structure forest ecosystems. Most of this work occurred under the umbrella of IUFRO, which also provided a global forum for dissemination of information. Many scientists from CINT have served as IUFRO officers, further attesting to the considerable leadership demonstrated in this region
- Research has traditionally been strong in the areas of tree genetics and breeding (including provenance testing), silviculture, protection (mainly pest management), forest management, and assessment of impacts by industrial pollution. The early occurrence of air pollution damage in the Czech Republic, Poland and the former GDR created good opportunities for the start of research on the impacts of air pollution on forest ecosystems. This research, although politically not very welcome, served to be an important milestone in the cause to decrease air pollution levels in Central and East European countries (Paule 1999)
- Different ecological conditions in the East European countries led to the development of individual site and soil classification systems which have resulted in schools of forest typology and improved forest management practices (Paule 1999)
- After World War II, significant research attention focused on the reclamation of degraded forest land, erosion control, and multipurpose forestry. The results of this work were soon applied towards afforestation and reforestation efforts particularly in Hungary, Romania and Bulgaria where 1 million hectares of non productive and abandoned

agricultural land were afforested by the end of the fifties and beginning of the sixties management (Paule 1999)

- Representatives of CINT contribute to ongoing international programs (EUFORGEN, ICP Forests), Task Forces, follow-ups of various activities of Helsinki and Montreal Processes etc. This is documented by the large number of workshops, seminars and other types of professional and scientific meetings that have been organized and continue to be organized in CEE
- Forestry experts from these countries also participated in various programs and projects in developing countries of Asia, Africa and Latin America (UNDP, FAO trust funds etc.).

Implications for Forestry Research

The seriousness and urgency of most of the forestry and environmental problems are linked to the inability or means of developing countries to provide appropriate scientific and technical knowledge, effective policy, regulations and planning frameworks to deal with the problems. These factors have many implications for the future of forestry research, and its organizational structures, priorities and delivery systems, including:

- The nature of forestry research to be undertaken in support of sustainable forest management is very complex and there is an urgent need to upgrade capabilities at all levels. Research capacity is particularly weak in countries where the problems are most acute. Often they are unable to even take advantage of the knowledge/skills developed elsewhere and adapt them to their specific conditions
- Supporting sustainable management – whether it is with regard to natural forests, plantations or other land uses – will be the key concern of forestry research in all the countries. Forestry research should lead to a better understanding of the concepts and approaches and provide better tools for sustainable forest management making it more profitable and acceptable than unsustainable forest management
- Research management has not received adequate attention and, in many countries, system-wide deficiencies hamper scientific progress. There is an urgent need to strengthen management capabilities, including timely reorganization and restructuring of research systems to ensure that they play a lead role in contributing to forestry science
- Effective priority setting is a process that is under-utilized in most developing countries. The process should include assessment of the potential benefits, potential for scientific progress, capability to undertake research and research organization
- Strengthening the capability to access, screen and adapt existing knowledge and skills will be an important step to immediate upgrading of technological capabilities. In the context of increasing restrictions to free access to knowledge and skills, national research systems and regional research support mechanisms will have to develop

well-defined policies and strategies to take advantage of technological developments

- The skill requirements in the next century are expected to be drastically different from what they are today; unfortunately insufficient efforts are being made to identify these and to develop the necessary capability. Research institutions will have to develop mechanisms to widen their scientific capabilities and develop arrangements to include disciplines and specialties that are traditionally not included under the purview of forestry research
- As scientists within an institution learn to work effectively as a team, their productivity is likely to increase together with the quality and relevance of their work. As this happens, the scientists and their institutions may gain more recognition and influence in their country and beyond. This could lead to increased core funding by the government or by international Agencies or donors and a more influential voice in developing options and alternatives for policy development
- Collaborative arrangements within and between countries are generally very weak and there is inadequate interest and commitment to regional initiatives that could cost-effectively supplement and complement national and international efforts.

Key Points and Recommendations for Delivering Knowledge for a Sustainable Future

New challenges are confronting the managers of the world's forests, with stakeholders demanding a broader range of goods and services, as well as a voice in setting priorities on the use of forests. Management is becoming more sophisticated and adaptive, seeking to achieve balance among multiple products and services. Good science has a vital role in generating new information that can provide input to the international dialogue on forests through the provision of synthesis of existing information and knowledge; the generation of new policy-relevant information in identified priority areas; and the input of expert technical advice as requested by international bodies (ICRIS 1998). But how can the generation and flow of the required knowledge be ensured? We offer some important considerations and recommendations to address these issues at the global, regional and national levels.

At the global level:

Key Points:

- Meeting the diverse needs of the large number of forestry stakeholders and, in particular, enhancing the role of forests in poverty alleviation, and protecting and enhancing the biodiversity and other environmental values of forests, requires substantial efforts to strengthen the knowledge-generation process at all levels (ICRIS 1998).

- Policies and actions covering the global, regional and national levels, aimed at strengthening sustainable management of forests, require a more integrated and holistic knowledge base than is currently available (ICRIS 1998).
- Global and regional problems, such as deforestation, declining environmental quality and reduction in biodiversity require local solutions based on integrated approaches that take full advantage of local/indigenous knowledge strengthened through application of developments in frontier areas of science (ICRIS 1998).
- Many investments in research yield high rates of return in the long-term, and can have significant multiplier effects. Furthermore, many forestry programs and projects without research components have failed to produce the desired results because of inadequate understanding of the underlying scientific principles (ICRIS 1998).
- Donors do not currently place much importance on the capacity for or the outputs from forestry research, as it is perceived that such investments do not directly benefit the poor (Sayer and Hunter 1998)
- Research and technology development capacities of most developing countries are highly underdeveloped and they are unable to participate in the process of knowledge generation as equal partners. The gap between the developed and developing countries with regard to science and technology is widening, accentuating the existing disparities (ICRIS 1998).
- The most important product of research in developing countries is research trained people rather than research results. Those research activities that help train new talent then become of the highest importance (Michaelson et al. 1998).
- More than the narrow technical aspects of research, it is important to consider the policy context and institutional changes as well as how research organizations can address these emerging issues and adapt themselves to the ever-changing conditions (ICRIS 1998).

Recommendations:

- Institutional capacity should be developed by increased country capacity for the planning and implementation of forest management programmes (Michaelson et al. 1998)
- Funding mechanisms should become more responsive to the evolutionary nature of capacity-building and to be structured less on the 'start-stop' basis associated with conventional project financing (Michaelson et al. 1998)
- Donors should be helped to recognize that wise investment in forest research capacity building coupled with an increased emphasis in transfer research results can lead to poverty alleviation
- Developing countries should be encouraged and supported to define their own long term forestry research policies (particularly their contribution to poverty alleviation); international cooperation programmes need to support forestry research capacity building within these policies Michaelson et al. 1998).

At the regional level:

Key Points:

- Research pooling through networking to share and exchange experience, results and personnel should be endeavored as an essential tool in research capacity building (Michaelson et al. 1998).
- Much information has been generated about forests and forestry in developing regions but it oftentimes is inaccessible to other researchers even within the same country and institution.
- Research information is usually not delivered in forms that will lead to its use in improving regional policy decisions concerning forests.

Recommendations:

- Increase support for scientific forestry research and technological development on a regional basis. The interest and support of donors must be engaged by developing new "sales" approaches which present a coordinated vision that better relates research objectives to relevant issues.
- Build strong forestry research networks in all regions to improve communication between scientists. This will reduce duplication of scientific efforts provide opportunities for complementary work and thereby mitigating the effect of the constraint associated with the inherent "lack of critical mass of scientists" (Nair and Dykstra. 1998).
- Efforts to take full advantage of the opportunities for regional and global networking should be strengthened and networking should become an integral part of the strategy for research. Such efforts should be focused on areas and skills so that it could provide cost-effective and timely solutions. Ongoing regional networking efforts (like AFORNET and APAFRI) should be strengthened through active involvement of national institutions.
- Particular effort should be made to ensure that the information is presented in forms that are appropriate to the users – policy makers, professionals and the public.
- Develop a Global Forest Information Service (GFIS) to enhance access to all forest-related information. Such access will ensure that such information is accessible to all stakeholders including policy-makers, forest managers, non-governmental organizations (NGOs), community groups and the public at large (Päivinen et al. 1998).

At the national level :

Key Points:

- Research information is usually not delivered in forms that will lead to its use in improving the lives of local communities and people.
- Universities are important but underutilized sources of expertise (Kowero and Spilsbury 1997).

- Political commitment to research is low as the benefits of research are difficult to quantify and usually must be viewed as a long-term investment.
- Stakeholders must become integral parts of the knowledge generation process by helping in the formulation of research priorities and ensuring that research products are translated and transferred into applications.

Recommendations:

- Strengthen the human, equipment, financial, and communication capacities of national forest research institutions through a process that builds political support, develops local and national research priorities, and ensures donor commitments.
- Efforts should be strengthened to review and redefine the strategy for forestry research and to develop an appropriate mechanism to periodically assess the developments in forestry science and to ensure that research is geared to meet current and emerging problems and incorporates stakeholder involvement.
- Research priority setting process should be improved at the national and institutional level to ensure that the limited resources are efficiently and effectively utilized.
- Mechanisms for inter-institutional collaboration (including universities) within the countries need to be strengthened so that duplication of efforts is avoided and the benefits from the varied strengths of the institutions are fully taken advantage of.
- Information support services at the national level and institutional level should be upgraded to take full advantage of the technological developments so that researchers and clients of research are able to take full advantage of the national, regional and global knowledge pool.
- Profiles of skill requirements should be carefully worked out and institutional arrangements refined to ensure that core competency is developed and retained in areas that are important or will become important in future.

Conclusions

While there is an overall recognition of the importance of science and technology in economic development, in general, many research fields outside health and traditional agriculture continue to be neglected in terms of resources made available and the priority assigned to it by many national governments and international aid organizations. This is also the case for forestry research. Even with the perceived need for improved technologies for conservation and management of forest and tree resources, forestry research has not been able to attract adequate attention from planners and policy makers. Moreover, increased investment in the forestry sector has not been matched with improvements in technological capability that could in the long run affect the ability of the sector to meet the increasing demand for goods and services. Partly this reflects the

overall neglect of the forestry sector but can also be attributable to institutional weaknesses (Szaro et al. 1998).

Many developing countries do not have the capacity to develop and promote national research programs or to effectively participate in international research projects. It is important to consider not only the narrow issues of technically-oriented research priorities and infrastructure but also how research organizations can address the policy and institutional changes taking place and adapt themselves to ever-changing conditions and emerging issues. To be successful and have more than limited impact, research programs must incorporate appropriate regional and local stakeholder participation. The need for greater involvement by non-government organizations, and to address a wider array of clients, has become increasingly clear. Thus, building support for forestry research development and improving regional, national and international forestry research networks with wider participation should be an important target for research capacity building efforts.

Finally, in terms of our three keys, information, innovation, and implementation, to sustainable forest management:

Information

- *Information development* is required to address the underlying causes of forest degradation and ways to assess progress towards sustainable forest management.
- *Information dissemination* is crucial for information not distributed is wasted and oftentimes leads to duplication. The ways and means to accomplish this distribution should include global, regional, and national networks as well as the more traditional approaches.
- *Information translation and transfer* to allow technical research results and analyses to be accessible and utilized in practical ways by users. This not only adds value to the research findings but also generates appreciation and support for science at a more grass-roots level.

Innovation

- *Innovative mechanisms* are necessary to strengthen both individual forestry research units and the linkages between them to enable the concept of a "world-wide web of forest researchers" to function effectively and be closely linked with real-world forest management problems (Byron and Turnbull 1998).
- *Innovative research programs* are needed to address the integrative and multi-disciplinary science needed to address the complexities of sustainable forest management.
- *Innovative human resource development* requires new concepts and approaches in addressing training needs, incentive mechanisms to encourage staff retention, and developing appropriate centers of excellence.

Implementation

- *Implementation of practices and solutions* for sustainable forest management, e.g. role of various silvicultural practices in both allowing for extractive uses and conserving biodiversity, techniques applicable in community-based forestry, methods for restoration and reforestation.
- *Implementation of funding mechanisms* that aid in the strengthening of research capacity and in development of research priorities that address the needs of stakeholders.
- *Implementation of institutional restructuring* that ensures the basic framework is in place for development of the information and knowledge needed for sustainable development, and to create a nurturing environment for innovation.

References

- Asia-Pacific Forestry Commission. 1998. Asia-Pacific Forestry Towards 2010: Report of the Asia-Pacific Forestry Sector Outlook Study. FAO, Rome, Italy. 242 pp.
- Awang, K. 1999. Regional Seminar On "Asia Pacific Forestry Research - Vision 2010 ": Conclusions And Recommendations. Asia Pacific Association of Forestry Research Institutions, Serdang, Selangor, Malaysia (Also see IUFRO News 28(3): 13-15).
- Byron, N. and J. Turnbull. 1998. New arrangements for Forest Science to Meet the Needs of Sustainable Forest Management. Pages 345-358 in Enters, T., C.T.S. Nair, and A. Kaosa-ard (eds.), Emerging Institutional Arrangements for Forestry Research. Forestry Research Support Programme for Asia and the Pacific, FAO, Bangkok, Thailand.
- Enters, T., C.T.S. Nair, and A. Kaosa-ard. 1998. Emerging Institutional Arrangements for Forestry Research. Forestry Research Support Programme for Asia and the Pacific, FAO, Bangkok, Thailand. 403 pp.
- FAO 1996. Survey of tropical forest cover and study of change processes. FAO Forestry Paper No. 130. Rome, Italy.
- FAO. 1997. Issues and Opportunities in the Evolution of Private Forestry and Forestry Extension: In Several Countries with Economies in Transition in Central and Eastern Europe. FAO, Rome, Italy. 163 pp.
- FAO, 1999. State of the World's Forests. FAO, Rome, Italy. 154 pp.
- Hong, J. 1999. Challenges for Forest Science in China. . Paper presented at the International Seminar: *Forest Science and Forestry Contri-*

- ICRIS. 1998. Proceedings of the International Consultation on Research and Information Systems in Forestry (ICRIS), 7-10 September 1998, Gmunden, Austria. Federal Ministry of Agriculture and Forestry, Vienna, Austria. 161pp.
- Johnson S. and J. Castaño. Production and trade of tropical Timber in the Latin America/ Caribbean Region. ITTO Tropical Forest Update 8 (4): 20-22.
- Koshla, P. 1999. Challenges to Community Forestry in India. Paper presented at the International Seminar: *Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries*. 3 September 1999. Copenhagen, Denmark.
- Kowero, G.S. and M.J. Spilsbury. 1997. Capacity for Forestry Research in the Southern African Development Community. CIFOR Occasional Paper No. 11.
- Latin American and Caribbean Forestry Commission. 1999. State of the Forestry in the Region-1998. Forestry Series No. 12.. FAO Regional Office for Latin America and the Caribbean, Santiago, Chile. 33pp.
- Lee, D.K. 1999. Challenges to Forest Science in Asia. Paper presented at the International Seminar: *Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries*. 3 September 1999. Copenhagen, Denmark.
- Mujika, Kankolongo G.S. 1994. Rapport national sur les politiques forestières: Cas du Zaïre (Mimeo). Ministère des Affaires Foncières, Environnement, Pêche et Forêts, République Démocratique du Congo (RDC). 10 pp.
- Michaelson, T., R. Schmidt, and R. Szaro. 1998. Capacity Building for Forestry Research: Discussion Group Report. Pages 144-146 in Proceedings of the International Consultation on Research and Information Systems in Forestry (ICRIS), 7-10 September 1998, Gmunden, Austria. Federal Ministry of Agriculture and Forestry, Vienna, Austria.
- Nair, C.T.S. and D.P. Dykstra. 1998. Roles of Global and Regional Networks and Consortia in Strengthening Forestry Research. Pages 63 -82 in Proceedings of the International Consultation on Research and Information Systems in Forestry (ICRIS), 7-10 September 1998, Gmunden, Austria. Federal Ministry of Agriculture and Forestry, Vienna, Austria.

- Nair, C.T.S., T. Enters, and B. Payne. 1995. Report on the Workshop on Barriers to the application of Forestry Research Results. CIFOR Occasional Paper No. 5.
- Nielsen, I. 1999. Welcome and Opening of the Seminar. Paper presented at the International Seminar: *Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries*. 3 September 1999. Copenhagen, Denmark.
- Päivinen, R., Iremonger, S., Kapos, V., Landis, E., Mills, R., Petrokofsky, G., Richards, T and Schuck, A. 1998. Better access to information on forests. Pages 113 – 132 in Proceedings of the International Consultation on Research and Information Systems in Forestry (ICRIS), 7-10 September 1998, Gmunden, Austria. Federal Ministry of Agriculture and Forestry, Vienna, Austria.
- Paule, L. 1999. Contributions from Forest Science in Countries in Transition. Paper presented at the International Seminar: *Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries*. 3 September, 1999. Copenhagen, Denmark.
- Sabogal, C. 1996. Prioridades de la Investigación Colaborativa en America Latina. CIFOR/ Embrapa Special Paper. Bogor, Indonesia. 126 pp.
- Salleh, M.N. 1999. Use of Biotechnology in Conservation of Tropical Forests. Paper presented at the International Seminar: *Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries*. 3 September 1999. Copenhagen, Denmark.
- Sayer, J. A. and I. Hunter. 1998. Changing Pattern of Research Funding: Threat or Opportunity. Pages 101-112 in Proceedings of the International Consultation on Research and Information Systems in Forestry (ICRIS), 7-10 September 1998, Gmunden, Austria. Federal Ministry of Agriculture and Forestry, Vienna, Austria.
- Shumba, E.M., I.B. Nyoka and D. Mabvurira. 1999. Forestry research and its contribution to improving commercial forestry practices in Zimbabwe. *International Forestry Review* 1 (2):97-101.
- Szaro, R.C., E.W. Thulstrup, W.W. Bowers, O. Souvannavong, and I. Kone. 1998. Mechanisms for Forestry Research Capacity Building. Pages 83-100 in Proceedings of the International Consultation on Research and Information Systems in Forestry (ICRIS), 7-10 September 1998, Gmunden, Austria. Federal Ministry of Agriculture and Forestry, Vienna, Austria.

- Vancura, K. 1999. Challenges for Forestry in Countries in Transition.
Paper presented at the International Seminar: *Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries*. 3 September 1999. Copenhagen, Denmark.
- Yapi, A. 1999a. Forests and Forestry Research in Sub-Saharan Africa: Background and Perspectives for Capacity Building Efforts in Africa. IUFRO News 28(1):13.
- Yapi, A. 1999b. Some Emerging External Issues Influencing Forestry Research in Africa. IUFRO News 28(2):13-15.
- Yapi, A. 1999c. Some Social Changes Influencing Forestry Research in Africa. IUFRO News 28(3):17-18.
-

Robert C. Szaro

International Union of Forestry Research Organizations
Special Programme for Developing Countries
Seckendorff-Gudent-Weg 8, A-1130 Vienna, Austria
fax: +43-1-8779355
tel (org): +43-1-8770151
e-mail: (pers) szaro@forvie.ac.at
e-mail: (org) iufro@forvie.ac.at

Atse M. Yapi

International Union of Forestry Research Organizations
Special Programme for Developing Countries
c/o FAO-Accra, P.O. Box 1628, Accra, Ghana

David Langor

Empresa Brasileira de Pesquisas Agropecuária (EMBRAPA)
Centro Nacional de Pesquisa de Florestas
CP 319-83411-000, Colombo Parana, Brasil

Erich Schaitza

Empresa Brasileira de Pesquisas Agropecuária (EMBRAPA)
Centro Nacional de Pesquisa de Florestas
CP319-83411-000, Colombo Parana, Brasil

Kamis Awang

Asia Pacific Association of Forestry Research Institutions
APAFRI Secretariat, Faculty of Forestry, Universiti Putra Malaysia
43400 UPM Serdang, Selangor, Malaysia
fax: +60-3-9432514.
Tel: +60-3-9487835
e-mail: kamis@admin.upm.edu.my

Karel Vancura

Ministry of Agriculture of the Czech Republic Branch of Forest Management
Tesnov 17, 11705 Praha 1, Czech Republic
fax: +420-2-21812988
tel (org): +420-2-21812357
e-mail: (pers) vancura@mze.cz.



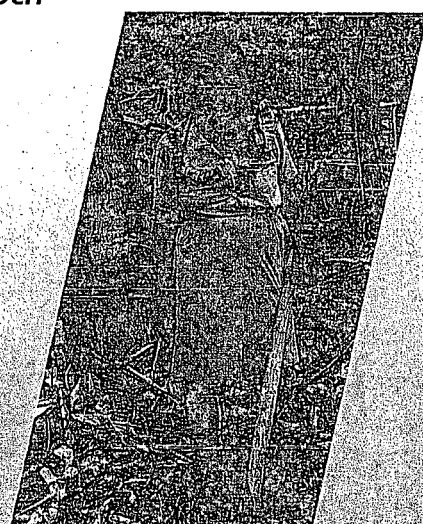
Skov & Landskab

Proceedings
No. 4 • 2000

Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries

*Proceedings of a IUFRO Seminar in Copenhagen,
3rd September, 1999*

*Jens Nytoft Rasmussen, Niels Elers Koch
and Torben Lang (eds.)*



Title

Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries

Editors

Jens Nytoft Rasmussen, Niels Elers Koch and Torben Lang

Publisher

Danish Centre for Forest, Landscape and Planning.

Series

Proceedings no. 4-2000

Editor-in-chief

Niels Elers Koch

Layout

Dorthe Gartmann Christiansen og Nelli Leth

Citation

Jens Nytoft Rasmussen, Niels Elers Koch and Torben Lang (eds.)
1999: Forest Science and Forestry Contributing to Quality of Human Life in Developing Countries. Proceedings of a IUFRO Seminar in Copenhagen 3rd September, 1999. Danish Centre for Forest, Landscape and Planning, Hørsholm, pp.130.

ISBN

87-7903-049-1

ISSN

1399-2163

Printing

Holte Bogtrykkeri A/S, 2840 Holte

Number printed

300 eks.

Price

150 Dkr.

Photos

Jens Nytoft Rasmussen

This publication is available from:

Danish Forest and Landscape Research Institute
Hørsholm Kongevej 11
DK-2970 Hørsholm
Tel. + 45 4576 3200
Fax + 45 4576 3233
E-mail fsl@fsl.dk

