Priorities for international forest research

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SUMMARY

The world is moving towards knowledge-based societies. Economies are globalizing. The global public goods value of forests is being recognized at the same time that the traditional role of state forest agencies in production forestry is being taken over by multi-national corporations. At the same time emerging technologies are greatly enhancing our ability to assess and monitor forest attributes, process and disseminate information and enhance forest production. All of these changes will have an impact on how forest research is organized, who does it and who pays for it. It seems inevitable that much traditional forestry research concerned with sustainability and productivity enhancement at the stand level, will be taken over by the private sector. However, there is going to be a major challenge in finding resources for research in support of the public goods values of forests at both the local, national and global levels. There is a widely held view that we are in the midst of a world forest crisis. It is not a crisis of declining production but one of erosion of the public goods, environmental values of forests. So far, we have not seen a concerted scientific response to this crisis, the Inter-Governmental Panel on Forests (IPF) has given us the mandate to orchestrate such a response and the World Forestry Congress is valuable opportunity to provide impetus to a new vision of forest science for the 21st century.

NEW IMPERATIVES

Knowledge, rather than the endowment of natural resources, is becoming a primary determinant of the economic performance of nations. Countries which have invested heavily in science and technology are observed to make more rapid economic progress than those that have not. Economists now use science and technology investment figures as indicators of potential economic prosperity. Many industrialized countries invest up to 3% of their GNP in R&D whilst most developing countries invest very much less, often only a fraction of 1%. They are currently being urged to invest more and some countries such as Malaysia have set targets to greatly increase R&D investments in coming years. In assessing the potential of corporations it is also common to use their investments in research and development as an indicator. Advanced-technology corporations often reinvest 10, 20 or 30% of their annual turnover in R&D.

In the natural resource context, it is common to rank countries and corporations on the basis of the percentage of product value that they reinvest in R&D. In agriculture, this percentage is often 2 to 3%. In forestry, it is much less than 1% (CIFOR 1993). A number of studies conducted at the time that Center for International Forestry Research (CIFOR) was being established (1993) concluded that investments in forestry research were much lower than those in almost any other comparable

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area of human activity. Forestry continues to "buck-the-trend" towards greater investment in R&D.

It is in this context that the deliberations of the IPF have increasingly focused on the need for research. The report which emerged from IPFIV in New York in February 1997 gave more prominence to research than previous documents emerging from international negotiations on forests. It has become clear throughout the IPF process that there are still great scientific uncertainties on global forest issues. IPFIV recognized the need for a thorough review not only of the research that is required but of the mechanisms that exist to execute that research and to generate resources to support it.

The IPF report recognizes that there is a need for greater co-ordination and for the exploitation of synergies between the work of organizations such as CIFOR, International Centre for Research in Agroforestry (ICRAF), the European Forestry Institute (EFI), the International Boreal Forest Research Association (IBFRA), Food and Agriculture Organization (FAO), International Tropical Timber Organization (ITTO) and of course International Union of Forestry Research Organizations (IUFRO). During the period of the IPF debates there were also suggestions for the establishment of new forest research capacity in Russia to address the needs of boreal forests and for a much greater focus on forests and natural resources in the work of Tropical Agriculture Research and Higher Education Center (CATIE) in the Americas.

RESOURCES FOR FORESTRY RESEARCH

The need for forestry research has finally been recognized but unfortunately this recognition has come at a time when conventional resources available for public sector research are stagnating or declining. The Consultative Group on International Agricultural Research (CGIAR) which was established to support a number of international research institutes engaged in crop improvement in the early 1970s is illustrative of this point. During its first 20 years the CGIAR enjoyed a healthy rate of financial growth. Most of its funding came from the major aid donors of the OECD. However, since 1990 it has been much harder for the CGIAR to find funds and such growth as has occurred has come from restricted sources of funding for specific research activities. The sort of funding that the CGIAR was set up to assure, to support long-term, high-technology, international public goods research, has become less attractive to donors. It is precisely this sort of funding that is needed for forestry because of the long pay-off periods involved and the public goods nature of most of the potential benefits.

However, if the research effort that is required to address global forest problems is to be realized, it seems almost certain that it will not be entirely funded from the conventional OECD aid budgets. It should be noted that the World Bank predicts that in the next one or two decades some of the world's most important tropical forest countries will be amongst the world's leading economic powers. The G7 of the year 2020 may include Brazil, Indonesia, India and China. These countries already make major investments in research and if forestry research needs in the 21st century are to be met, it seems inevitable that these and other tropical countries will have to bear an increasing share of the burden. In the closing years of the 20th century, we are also seeing the emergence of major multi-national corporations operating in forestry. It is to be hoped that these will be concerned with the sustainability of the resource base of their industry and will be prepared to allocate resources to support not only research and development addressing their own production needs but also to support public goods research.

THE IMPACT OF INFORMATION TECHNOLOGY ON RESEARCH

Many forest problems have to be researched at a local or regional level. Yet very few libraries in the world have comprehensive collections of literature on forests. Most of the best libraries are in the developed world. Forest researchers throughout the tropics have great difficulty in accessing the literature that they require as a basis for their research. It would be virtually impossible for a new

research centre in a tropical developing country to accumulate a critical mass of printed literature on forests in a short space of time without a huge financial investment. Fortunately, major revolutions are occurring in the possibilities for storing information in electronic form and in the technologies that allow it to be shared. From 1997 onwards CIFOR will put all of its annual publications onto a CD-ROM and distribute this free to its major stakeholders. We are urging other research organizations operating in forestry to do the same. The availability of information on CD-ROMs is rapidly increasing. The World Conservation Monitoring Centre has put forest maps of the world on a CD-ROM. CABI has for some years produced Tree-CD which contains citations and abstracts of mainstream forestry literature dating back to the 1930s. Numerous other abstracting services in Europe and North America are now dealing with natural resources and forestry material. Increasingly all this information is becoming available on the Internet and more and more developing country scientists are getting access to advanced information technology. We can be reasonably optimistic that electronic communications are going to enormously facilitate access to information for the forest scientists of the next century. Perhaps one of the new challenges will be sorting out the quality information from a large volume of poor-quality or irrelevant material which may begin to clutter up cyberspace and slow down meaningful electronic communications.

REMOTE SENSING

The closing years of the 20th century have also seen enormous advances in the availability of high-quality remotely sensed imagery dealing with forests and natural resources. The development of the capacity to interpret this information digitally and the advent of widely available radar images covering the world's forests are all leading us to a situation where information on at least some broad-scale attributes of forests will be readily available for the entire world and in a form that permits time series comparisons. The forest assessments of 1980 and 1990 were based upon assemblages of national information and low-intensity sampling of forest areas. The analysis was carried out in dispersed localities by people with different competencies, and the 1980 and 1990 estimates were derived by extrapolations (rather than from actual field measurements in those years). We are witnessing the emergence of a small number of centres of excellence with the capacity to treat large amounts of data in efficient ways and to make the results of their work widely available. The work of the TREES project supported by the European Union and of the Pathfinder project in the USA are notable examples.

THE CULTURE OF SCIENCE

As well as improved science and more science, there is also a widely perceived need to change the culture of science as applied to forests. The issues concerned have been reviewed in CIFOR's initial medium-term plan (CIFOR 1993) the "Bali Dialogue" (CIFOR 1995) and in CIFOR's strategy (CIFOR 1996). In the past, most forestry research was carried out by public sector forest research institutes whose primary mandate was the national forest estate. The normal scale at which research was conducted was that of the management unit or forest stand. Foresters did not in general look outside the limits of the forest that was allocated to their state forest service. A high proportion of research was concerned with improving productivity for timber - genetic improvement of trees, site management, silvicultural treatments, and inventory and monitoring of forest stands. The needs identified by the IPF are for research which provides answers to the questions posed by a much broader set of forest stakeholders. It has become apparent that major determinants of the extent and condition of forests are decisions that are taken entirely outside the forest sector. These include decisions taken with regard to infrastructure, agricultural and trade policies, resettlement of migrants, fiscal policies, etc. A whole new body of research is needed to enable us to understand the implications

of extra-sectoral decision-making on forests. There is also a need to better understand the relationships between people and forests at the local community and household levels, and then the connections between these micro and macro studies (CIFOR 1996). These needs suggest that research relating to forests must embrace a new scientific culture which includes investigation of extra-sector influences and social interactions in addition to the traditional disciplines of forest science.

THIRD GENERATION R&D

Some of the most interesting findings to emerge from forest research over the last few years have been from research that has been intimately associated with projects dealing with local management of forests. This research had much of the character of the so called "third generation research" (Rousell *et al.* 1991) which is much talked about in the context of industrial R&D. Rousell *et al.* portrayed industrial R&D as having evolved from first generation R&D where corporations recognized the value of research and established a research capacity in isolation from their day-to-day activities in the hope that it would yield benefits in the long term. The second generation was where corporations set tasks for their researchers to accomplish and provided funding against a requirement for specific outputs. This is the classic contract research which now dominates much work in forestry. Third generation R&D (which Rousell *et al.* claim is characteristic of more advanced corporations) is where the researchers and the corporate directors work together so that there is intense feedback between the research community and corporate management. Research is fully integrated into the day-to-day operations of the corporation. In some ways, the community based research on forests of the 1980s was a form of third generation R&D. Perhaps what has emerged from the IPF is the requirement for a third generation R&D operating at higher levels of aggregation. The US Forest Service Ecosystem Management Program and the Canadian Model Forest Program both integrate research into management at the landscape level. This would seem to us to be the form of third generation R&D which is likely to predominate in the forest sector in the early 21st century. It is R&D which recognizes the need to understand the relationships between interventions at different scales to take account of the interests of multiple stakeholders and of the need to be able to adapt management objectives to changes in stakeholder perceptions and requirements. It is the adaptive management advocated, for example, by Hollings *et al.* (1996), etc.

SYSTEMS APPROACHES TO FOREST RESEARCH

Research at all these scales can benefit greatly from the application of systems analysis to its conception and execution. The "systems approach," coupled with much greater capacity to manipulate spatial data through geographic information systems, is transforming our ability to predict outcomes of different management interventions in forests at a number of scales. We are already witnessing a move from reductionist forest science working at the level of components of forest systems to a more eclectic science attempting to generate insights into the functioning of the systems themselves.

INSTITUTIONAL ARRANGEMENTS FOR FOREST RESEARCH

Most research on forests has in the past been conducted by forest research institutes established within national forest departments. In some countries universities have had a capacity to conduct research and a lot of the work on the biodiversity of forests has come from academic institutions and non-governmental organizations. The private sector has dealt with a relatively narrow subset of research issues mainly dealing with trees for industrial plantations and technologies for harvesting and processing wood. In our introduction we speculated that increased investments in forestry research will come from the private sector more than from the traditional public sector research institutes. However, the difficulty of obtaining intellectual property protection on much of the output of forest

research and the increasing appreciation of the public goods nature of forests are likely to have an impact on who actually undertakes research in the future, and who pays for it.

Classic mainstream research on productivity enhancement, notably on genetic improvement, micro-propagation and related issues to improve planting material for industrial timber estates seem likely to move almost entirely into the domain of the private sector. Fewer and fewer governments are attempting to manage plantation forests and some very large corporations (and some smaller ones) are already at the cutting edge of the technologies involved. Private sector investments in biotechnology are already running far ahead of those from the public sector. Our prediction is, therefore, that this area of research will be almost exclusively the domain of the private sector in the 21st century. The benefits of such research can be readily captured and privatized. Consortia of private sector researchers (e.g. tree-breeders in Australia and New Zealand) can achieve economies of scale, reducing any comparative advantages State sponsored researchers may previously have held.

Processing and harvesting research and development may also move to the private sector. Advances in processing and harvesting will come from new and better machines and materials handling systems. This is one area where intellectual property protection does allow private sector research to capture the value of its output through patenting. The sophisticated feller-bunchers now found in the forests of Scandinavia are an example of private sector R&D. As societies impose stricter conditions upon the environmental tolerances associated with forest harvesting, the need for sophisticated technologies to reduce impacts will increase. This should provide a major opportunity for the private sector. The role of the State is not to do the research, nor to specify which technologies must be used, but rather to specify the acceptable impacts and performance standards that society demands. Industry can best devise ways to achieve the specified limits. This represents a change from a rule-based to a performance-based system.

There is a significant area of forest research whose products will be national public goods. This is research which deals with environmental and social issues of forestry and also with the needs for technologies, planting material and silvicultural methodologies and institutional and tenure arrangements for small producers. The latter technologies lie in areas where intellectual property protection is difficult. We would expect this to be the main focus for public sector forest research institutes in the future. These institutes will also have an important role in dealing with the increasingly complex issue of the silviculture of forests which are maintained primarily for amenity and environmental reasons but which are managed for a wide variety of goods and services destined for consumption at the local level. Much of this research will be locally specific in nature and of a type where few products will be commercialized and intellectual property protection will be difficult. This seems likely to become the main focus of national forest research institutes. It will require major changes in those institutes and particularly it will require them to mobilize more scientists from disciplines such as biology, the social sciences and economics.

There remains a significant area of research dealing with the international public goods derived from forests. These are the issues being dealt with by the IPF and they concern global environmental services such as carbon sequestration and biodiversity conservation. As the dominant role of national governments declines and global governance slowly becomes a reality and as the role of multinational corporations grows in importance, there are likely to be increasing research needs which will fall into the international public goods arena. Corporations are likely to re-locate to areas of comparative advantage for the production of forest products. Countries are likely to collaborate more and to recognize the significance of transboundary values of forests. This may lead to a whole new generation of research at levels of aggregation at which foresters have not worked in the past. If so, it will require the mobilization of new types of science. Geographers, political scientists and economists may become much more important players in global forest research.

CONCLUSIONS

This is the last World Forest Congress of the 20th century. It is taking place at a time when whatever inter-governmental process follows the IPF is likely to be looking seriously at research. We hope that some of the above discussion will lead this Congress in the direction of a consensus on what research we need, who should do it, who should pay for it and how it should be organized. At the moment forest research is trailing behind research in other areas of human endeavour. The concluding statement of this Congress should make a strong appeal to the international community for greatly expanded research in the 21st century. This new research should break free from the culture of research that predominated in the 20th century, should incorporate scientists from more disciplines and should deal with forests through a systems approach at a much higher level of aggregation than has been the case in the past.

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