



Forest Research in the Commonwealth

Edited by P.J. Wood, former Senior Forestry Adviser in the UK Department for International Development, with inputs from A. Brown (Australia), B. Chikamai (Kenya), J. Richardson (Canada), J. Innes (Canada), R. Sands (Australia), R.V. Singh (India) and W.R.J. Sutton (New Zealand)

Forestry research was started in the different countries that now comprise the Commonwealth at varying times between the mid-19th and early 20th centuries. Research into forest and tree biology was linked to the needs of forest and plantation management, whereas harvesting and utilisation research followed industrial priorities. Countries that have developed similar models have been grouped into the following regions:

- **Africa:** Forest research in the Commonwealth countries of Africa was historically based largely on the Indian model. South Africa in particular has a leading international role in research on plantations. Most countries have their own research institutions based on national and international priorities.
- **Australia and New Zealand:** Australia and New Zealand have high standards of forest research and are international leaders in sub-tropical and tropical plantation research.
- **Canada:** The most forest-rich country in the Commonwealth with most of its forest areas in temperate or boreal zones.
- **Cyprus, United Kingdom:** The two Commonwealth countries in Europe with a forestry sector are Cyprus and the UK. Cyprus has developed Mediterranean forestry technologies. The British Forestry Commission was created in 1919 with responsibilities for forest development in Great Britain, but many other forest-related research institutions were based on colonial needs and were established earlier.
- **Indian sub-continent:** India is the largest Commonwealth country with the longest tradition of scientific forest management which was based originally on central European traditions. Bangladesh, Pakistan and Sri Lanka have developed from the shared Indian model.
- **South-east Asia:** Malaysia is the principal country in this region, a leader in management of dipterocarp forests.

- **Pacific Islands:** Forestry in the Pacific Islands of the Commonwealth has many similarities with that in Australia and New Zealand, with emphasis on intensive forest management, both in natural forest and plantations. Much of the research done has relied on external assistance.
- **Caribbean and South America:** Including the Caribbean islands, Belize and Guyana, research has been on a small scale but to a high standard

■ Africa

History

Forest research in the Commonwealth countries of Africa was structured on the Indo-Germanic model. All countries concerned had a colonial background, although only those with cooler climates had large-scale European settlement and not all were originally British colonies; Mozambique, formerly a Portuguese colony is a major example. There is thus more variation between these countries than between Commonwealth countries in other parts of the world; they are subdivided as follows:

- **West Africa:** Cameroon, Gambia, Ghana, Nigeria, Sierra Leone;
- **East Africa:** Kenya, Rwanda, Tanzania, Uganda;
- **Central Africa:** Malawi, Zambia, Zimbabwe;
- **Southern Africa:** Botswana, Lesotho, Mozambique, Namibia, Swaziland, South Africa;
- **African Islands:** Mauritius, Seychelles.

In all countries, but especially in the smaller ones and the islands, it has often been difficult to sustain funding for research programmes even when qualified staff have been in post. Attempts to achieve economies of scale through amalgamation or through networking have therefore been common. An example of the former, now superseded, was the East African Agriculture and Forestry Research Organisation (EAAFRO).



The East African Herbarium still coordinates many aspects of forest and tree biology especially taxonomy, and more recently some regional forestry research has been carried out through the Southern African Development Community (SADC). The latest initiatives for African forest research networking include FORNESSA (Forest Research network for sub-Saharan Africa) sponsored by FAO and IUFRO, and AFORNET (African Forest Research Network) sponsored by the African Academy of Sciences (based in Kenya). Several research field stations in sub-Saharan Africa have been set up by the two Consultative Group on International Agricultural Research (CGIAR) centres CIFOR (Centre for International Forestry Research) and ICRAF (World Agroforestry Centre). Their remit is continent-wide and they play important roles in forest research in the Commonwealth countries in Africa.

Major achievements

Most of the western Africa countries are forest-rich and research departments were established in these countries before the First World War. Particular achievements include detailed studies on forest botany and silvics of major species, especially in the moist forest zones. The Forest Research Institute of Nigeria (FRIN) based in Ibadan, the Forestry Research Institute of Ghana (FORIG) in Kumasi and the Limbe Botanic Garden in Cameroon are particularly well-known. In eastern Africa all the countries have competent and productive research institutes, covering forest biology, silviculture and forest utilisation, as well as several well-established universities covering forestry in education and research. Considerable progress has been made in research on forest plantations and on community forestry as well as in forest botany and ecology. In southern Africa the out-



LEFT

The Kyambura Gorge Forest in Uganda – in eastern Africa all the countries have competent and productive research institutes.



standing capacity and facilities of South Africa have become increasingly accessible to support research in neighbouring countries of SADC, where, however, facilities are still under-funded despite often having a good record of research activity and publication. Outstanding achievements in industrial plantation management and forest products utilisation were achieved through both government and private sector research. Research into the ecology of the major vegetation types, including for example *Brachystegia* (miombo) and *Colophospermum mopane* (Mopane) woodland has been aided by collaboration with CIFOR.

Future challenges

A major challenge throughout Africa is the continuing education, funding and retention of forest research scientists. Funding for carrying out research from national governments is restricted and forestry is very much the poor relation when compared with “food producing” sectors, especially when the budgetary source is the same for both. The myth that forestry is an integrated part of agriculture is particularly strong in sub-Saharan Africa. The importance of increasing agricultural productivity in order to halt or delay deforestation is not always appreciated and the use of agro-forestry in the restoration of lands degraded by agriculture is not given due prominence in inter-sectoral research. That said, a number of smaller countries in Africa have developed competent forest research teams, in research institutions and universities, which are able to attract research funding internationally. The challenge is therefore to achieve visibility as well as viability.

There is a plethora of priority research topics for Africa, identified from the interests of participants in many conferences and workshops, and from potential donors. However, for all countries, climate change is of prime importance. Within this priority, research in support of the Millennium Development Goals

comprises the highest national priority areas. Other relevant topics include:

- Management of water catchments;
- Genetic erosion of endemic vegetation;
- Forestry as an agent for poverty reduction;
- Sustainability of all products and services; and
- Overall inter-sectoral land management policy, planning and practice.

Australia

History

Early forest research priorities were to select (mostly exotic) trees for a viable plantation industry and today's efficient programmes for conifer silviculture and utilisation are the result. Government-funded forest research institutions were set up separately by the states and by the federal government (Carron, 1985). Since 1991 cooperation between industry, the universities and government agencies has been fostered through a series of Cooperative Research Centres (CRCs)¹. For the last 16 years the Forest and Wood Products Research and Development Corporation (FWPRDC) and its successor, Forest and Wood Products Australia (FWPA)^{2 3}, have had an increasingly-important role as a coordinator and funder of research. Established in 1980, the Australian Centre for International Agricultural Research (ACIAR)⁴ has supported research of mutual interest to Australia and partner countries. The formerly prominent forestry and forest products divisions of CSIRO were disestablished as separate entities in 2008. Relevant expenditure in Australia was reported by Turner and Lambert (2005) – the forest and forest products research effort had declined by about half in the previous 25 years.

1 www.crc.gov.au/Information/default.aspx, www.crcforestry.com.au and www.bushfirecrc.com.

2 www.fwpa.com.au.

3 www.fwpa.com.au/Resources/About/annualrep/FWPA_Annual_Report_2009.pdf.

4 www.aciar.gov.au.



Major achievements

Extensive work on the taxonomy, ecology, silviculture and utilisation of the indigenous forest flora has been carried out. Many endemic species are of importance for plantation development in other countries, and now about 950,000 ha have also been established in plantations in Australia, mostly in the last 20 years. World-leading research was undertaken on plantations of indigenous and exotic species⁵. Timber technology research, including the development of papermaking from eucalypts (Algar, 1988) has supported highly efficient wood industries, and has been internationally recognised by the award of two Marcus Wallenberg prizes⁶. Fire has been extensively studied, and data on very high rates of spread have been incorporated in a

5 Exemplified in "IUFRO World Congress 2005 Host Scientific Awards to Drs Nambiar and Nikles", IUFRO News, Special issue, p. 6, from www.iufro.org/events/congresses/2005.

6 www.mwp.org/prizewinners.cfm.

better fire behaviour prediction system to forecast the spread and intensity of wildfires⁷.

Future challenges – resources for research

Research capacity in forestry and forest products in coming decades will be constrained by shortages of both skilled personnel and funds. The last two decades have seen significant reductions in the staff numbers of traditional research providers, an increased emphasis on short-term projects, and the diversion of staff from research projects to monitoring and consultancies. Many of the skilled personnel who have been "downsized" have remained on call in the workforce as contractors or consultants, but their former contributions to institutional memories and the mentoring of younger colleagues have been foregone, and their effectiveness is inevitably being eroded by increasing age and iso-

7 For example: www.bushfirecrc.com/publications/project_vesta2.html.

ABOVE

Sorting eucalyptus logs in Victoria, Australia, where the large area of maturing eucalypt plantations established in the last two decades presents a significant challenge for harvesting and marketing.



lation. Future research capacity is also threatened by a marked down-turn in undergraduate numbers (Kanowski, 2006), a problem in many countries. Although contemporary forestry problems may often be best addressed by teams including specialists from other disciplines, the consequent broadening of the potential pool of talent may be insufficient to meet national needs at a time of expansion of both the forest industry and the threats to it.

Some themes which have been identified for research attention are described briefly below.

New horizons for plantations

The large area of maturing eucalypt plantations established in the last two decades for fibre production presents a significant challenge for harvesting and marketing, as well as an opportunity to establish important processing capacity in Australia.

An ability to grow commercially-successful plantations in the seasonally-dry tropics of northern Australia, and in low-rainfall areas in southern Australia (e.g., land now used for wheat) would be valuable for several reasons: to expand and diversify regional economies (Underwood, 2006), to ameliorate land degradation resulting from salinisation (Maslin *et al.*, 2004) and to accumulate and store carbon from the atmosphere.

The hardwood dilemma

Australia has been very successful in developing timber industries based on softwood plantations, and more recently short-rotation hardwoods for fibre. These plantations, however, cannot supply a full range of timber products. In particular, strong durable timber for sawlogs, and hardwood for veneers, have been obtained from Australian native forests, but the supply is steadily diminishing (Kile, 2005) and their production from plantations faces economic, commercial and technical challenges, although recent developments in sawing and drying promise to enable plantations

originally established for fibre to be sawn profitably for structural products (Brown *et al.*, 2008).

Forest protection and sustainability

Both native forests and plantations are threatened by significant pests, diseases, weeds, droughts and fires. For example, Asian gypsy moth⁸ is regarded as a potentially-serious insect pest; pitch canker (Matheson, 2006) is a threat to pine plantations. Eucalyptus (guava) rust, established in the Americas, is a serious threat to both planted and native eucalypts. Fire, allied to drought, has caused large losses in 2003 (Kanowski *et al.*, 2005), 2006 and 2009⁹ and there have been forecasts that these will be greatly exacerbated by climate change¹⁰. Sustaining productivity will require ongoing research in forest health, stand management, nutrition and genetics.

Forestry and society

The social context of forestry has changed markedly in the last quarter-century, and some views on forest management (Poynter, 2005) and land use remain conflicting. Public pressure has resulted in the transfer of much native production forest to reserves, while the establishment of plantations on former agricultural land (encouraged by taxation concessions) is also a source of controversy (Schirmer *et al.*, 2003).

Water and climate change

The influence of forests on the quality and quantity of water yield from catchments has come to public attention as most cities in Australia face significant water shortages. Competition for water, essential for forest growth, is increasing (Clifton *et al.*, 2006, Nambiar *et al.*, 2005); it is proposed to thin or fell plantations near

8 www.affa.gov.au/content/output.cfm?ObjectID=A3F126C7-F434-4457-948251929FBD75BB.

9 www.royalcommission.vic.gov.au.

10 www.csiro.au/csiro/content/standard/ps271.html.



THE TANZANIA FORESTRY RESEARCH INSTITUTE

The Tanzania Forestry Research Institute (TAFORI) is a National Institution which was established by Act No. 5 of 1980. It has the mandate to conduct, coordinate and promote the carrying out of Forestry Research as well as to ensure documentation and dissemination of research results for sustainable forest management in the country and to contribute to the enhancement of socio-economic and environmental benefits for present and future generations.

TAFORI's Vision: To have and maintain a recognised position of one of the knowledge and technology contributors leading to sustainable management of forests and allied natural resources for balanced science-based enviro-socio-economic benefits.

TAFORI's Mission: To enhance research capacity for effective carrying out, co-ordination, documentation and dissemination of research results for sustainable forest and associated natural resources management to enhance economic, social and environmental benefits to stakeholders.

Function of the Institute: The Tanzania Forestry Research Institute is a corporate body, which carries out the following functions: sets up experiments relating to planting, growth, development and conservation, and the use of local and exotic tree species; investigates causes and suggests ways of controlling and preventing the occurrence of forest diseases and pests; coordinates research and provides advice to the government, public institutions and other persons on the practical applications of modern techniques suitable for development and conservation of the soil, fauna and flora; provides advice on the establishment and development of wood industries; cooperates with the Government and any person or group of persons in providing facilities for the training of researchers; establishes a system of documentation and dissemination of research results, by placing inquiries and/or collecting prepared and/or published statistics relating to forestry; encourages the development of forestry through the protection of the forestry

industry, provision of consultancy services, and increasing the supply, sale, utilisation and conversion of timber and carries out any other activity deemed by the Board of Directors as being of interest to the Institute.

The operational priorities are: Training researchers; building basic infrastructure at Morogoro, the permanent headquarters; strengthening research centres; disseminating research results and consolidating income-generating activities.

Research programmes include: Management of Natural Forests; Community and Farm Forestry; Plantation Forestry and Tree Improvement; Forest Resource Assessment; Forest Operations and Utilisation; Socio-economics; Policy and Forestry Extension.

Capabilities: TAFORI has the capacity to offer consultancy in Management of Natural Forests; Community and Farm Forestry; Plantation Forestry and Tree Improvement; Forest Resource Assessment; Forest Operations and Utilisation; Socio-Economics, Policy and Forestry Extension. In an attempt to consolidate income-generating activities, more than fifty consultancies have been undertaken by TAFORI between 1987 and 2009. Five in Community and Farm Forestry, twenty in Management of Natural Forests, five in Plantation Forestry, twelve in Forest Utilisation and eight in Forest Resource Assessment.

TANZANIA FORESTRY RESEARCH INSTITUTE (TAFORI)
P.O. Box 1854
Morogoro
Tanzania

Tel: +255 023-2614498
Fax: +255 023-2613725

E-Mail: tafori@morogoro.net
Website: www.tafori.org



Perth to increase catchment water yield.

Climate change promises to have a profound effect on Australian forests. It is expected that an already very variable climate will become even more erratic, and that there will be more prolonged droughts and higher temperatures over extensive areas. These changes are likely to detract from forest growth, and to increase vulnerability to pests and diseases, and particularly fires. In some regions of southern Australia droughts and fires have already significantly damaged the forest estate.

■ New Zealand

History

New Zealand forestry originally followed the Commonwealth "norm" of a Forest Service responsible for a government forest estate, within which a Research Section carried out research. Today, the NZ Forest Service is no longer in existence, the outstanding plantation forests are owned by the private sector and research is carried out by a Crown Research Institute called Scion, (formally the Forest Research Institute which later became Forest Research). Although other New Zealand organisations carry out some research in forestry their contribution is very small compared with that of Scion. The Forest Research buildings, staff numbers and overall budget are much as they were but the research emphasis and sources of funding have changed.

Achievements and challenges

There is now less emphasis on growing forests (and less emphasis on pine plantations), although *Pinus radiata* still dominates (89% by area) New Zealand's plantation resource with its outstanding rate of growth and its very positive response to stand treatment. In the past there was considerable emphasis on plantation regimes but now priorities have changed with a much wider research emphasis – viz, realising the economic potential of environmental values, measuring forestry's

carbon footprint, climate change, unlocking gene data-banks, etc. New Zealand has millions of hectares of marginal land – land currently uneconomic and unsuitable for sustainable intensive food or feed production – and there is ongoing research on how to transform this land so that it is suitable for tree growing.

There is also greater emphasis on increasing the profitability of the New Zealand Forest Industries, especially solid wood processing. As well as a better means of predicting radiata pine quality there is also research on the acetylation which, by modifying physical and chemical properties of wood, has the potential to endow plantation-grown softwoods with the performance properties of the very best tropical hardwoods.

Another important research area is what Scion refers to as the bioeconomy (lignocellulosic materials, bioplastics, bioenergy, etc.). Whilst it is very unlikely to reward forest growers with greater stumpage returns this research could be very important to replace our dependence on fossil fuels.

Some research funding still comes as a central government grant but this is not as generously available as in the past. Increasingly, research funding comes from contracts some of which are with other government organisations, and, unheard of in the past, research funding is now expected to return a profit – in the 2008/2009 year the net profit was some NZ\$2.3 million (on an operating revenue of NZ\$44 million).

Not all Scion's research is directly related to forestry and as the country tries to reduce its national carbon footprint Scion is increasing research in all aspects of carbon accounting.

■ Canada

History

Canada, like India and Australia, is a federal nation in which the greater part of forestry activity is decentralised, with responsibility for forest management lying



with the provinces. Canada's forest traditions owe more to the ideas of Pinchot, who was the founder of the US Forest Service, than to the Germanic/Indian tradition that lies behind the structure of forestry in the other Commonwealth regions. The Canadian Forest Service is the primary agency for forest research at the federal level. The research is conducted in a series of regional centres and also, for a period, in several national research institutes. A separate Forest Products Research branch, with two laboratories, provided research in solid wood products until the 1970s when it was privatised as Forintek Canada Corporation. The forest industry funded and set up the Pulp and Paper Research Institute of Canada and later the Forest Engineering Research Institute of Canada. The work of these labs and institutes has continued to be supported by the federal government as well as by the forest industry, and has now been combined into FP Innovations. The newly established Canadian Wood Fibre Centre of the Canadian Forest Service takes its research direction from the CEO and Board of FP Innovations as part of the strong relationship between industry and federal research.

Most of the provinces have had their own forest research divisions, but presently only British Columbia, Ontario and Quebec still maintain separate forest research groups. Universities have always been an important part of the forest research effort in Canada. Four universities have a long history of forestry education and research – University of British Columbia, University of Toronto, Université Laval (Quebec City) and University of New Brunswick. Since the 1970s, more universities have developed specific forest research programmes, and a number of others have faculty members involved in forest-related research. Academic standards are ensured through an accreditation programme run by the Canadian Forestry Accreditation Board, which has recently changed to a results-based



approach to assessing individual programmes (see *Chapter 5*). Currently, some university forestry programmes are under review and the future composition of university-based forestry education and research in Canada is likely to change significantly in coming years.

The Sustainable Forest Management Network (SFM Network) was established in 1995 as one of Canada's Networks for Centres of Excellence (NCE). It encouraged networking between researchers, governments, industry, First Nations and others, and provided funding for research on all aspects of sustainable forest management. The Network placed particular emphasis on the training of future forestry researchers: 26 students from the programme are now in academic positions in universities in Canada, over 75 are now working for provincial territorial and federal government departments and more than 50 are employed with industry and consulting companies.

ABOVE
Mountain Pine Beetle damage in British Columbia – the epidemic is an example of a climate-mediated event affecting the Canadian forestry sector.



Major achievements

Much expertise has been developed and results published in forest health – entomology and pathology – as well as in silviculture, ecology and fire management. Driven by Canada's vast geography, particular progress has been made with applications of remote sensing and geographic information systems to forest inventory and management. The results of research have been applied in the innovative Model Forest Program, which includes an international component developed through partners in other countries (*described in Chapter 2*). Canada currently has 14 Model Forests that bring together hundreds of partners, including private citizens, forest companies, parks, Aboriginal communities, provincial governments and universities. Primary funding comes from the Natural Resources Canada – Canadian Forest Service through the Forest Communities Program, with additional support for each Model Forest coming from within its partnership.

Future challenges

As economic events of 2008 were described by both government and industry as "the perfect storm", the future outlook for forestry in Canada can only be positive. However, there are significant challenges ahead. Climate change in particular is creating uncertainty. While many areas may benefit from increased growth rates, the effects on ecosystems are less certain. In addition, warmer climates may make forests more susceptible to pests and disease, with the Mountain Pine Beetle epidemic in British Columbia and the Western Spruce Beetle outbreak in Yukon being good examples of climate-mediated events. Concurrently, the Canadian forestry sector continues to struggle. Exports are still largely focused on the USA, and the sector is therefore dependent on the health of the US economy. Some market diversification is occurring, although while

exports to Asia are increasing, they are still only a small proportion of the exports to the USA.

The future of forestry research and education in Canada is also very uncertain. The federal and provincial governments have cut back forestry research expenditures, and the perilous financial state of most companies means that most industrial R&D is negligible. Universities are also undergoing a period of change, and some of the current departments and faculties seem likely to close. The professional forestry associations remain relatively healthy but will be challenged by the fundamental changes that are occurring in the nature of the profession. As the number of locally trained foresters declines, the associations will need to adopt more flexible approaches to those trained and qualified elsewhere.

Current priorities include woodlands and the environment (understanding the complex interactions between forests and their physical and historic environment) and the protection of trees and forests from threats such as insects and disease remains an important ongoing programme.

Commonwealth countries in Europe

The two European Commonwealth countries with significant forestry programmes are Cyprus and the United Kingdom.

Cyprus

The Republic of Cyprus has a long tradition of natural and plantation forest management and its forestry training school has a high international reputation. Research is based in the Forest Service and organised on the Indo-Germanic model. Notable research has been carried out into reforestation and forest protection, from which field-tested technologies have been developed. Future challenges include the impacts of climate change.



United Kingdom – history

The British Forestry Commission was established in 1919, adopting many of the practices already developed in India, including the creation of research units within the forest service. Since the UK, and England in particular, was, and still is, very substantially deforested, research was initially focussed on supporting the national policy of creating a national strategic resource of lumber, mainly for mining. After the Second World War, emphasis gradually shifted to concerns related to the financial viability of tree growing, and subsequently to environmental and social benefits. Much, if not most, of the planting is done by the private sector, often heavily subsidised by government. The Forestry Departments of the four universities of Aberdeen, Bangor, Edinburgh and Oxford carried out research mainly on British priorities but also on overseas topics.

A number of research institutions were set up specifically to address needs for research for the developing countries of the then empire, and several of these, such as the Colonial Pesticides Research Unit in Tanzania and the Imperial College of Tropical Agriculture, Trinidad were located in the developing countries themselves. The Imperial Forestry Institute was set up at Oxford University, which, in its role as the Commonwealth Forestry Institute, later the Oxford Forestry Institute, played a leading role in tropical forest research on a broad range of subjects. (The Institute closed in 2004; for a brief account of its achievements see Burley et al., 2009). Major herbaria, timber research laboratories, pest and biological control research laboratories and specialised university departments were also established. The latter have been particularly adept at keeping in the forefront of socio-economic research needs. However, since the 1990s there seems to have been a steady decline in forestry research especially on tropical forestry.

United Kingdom – major achievements

The research objectives of the Forestry Commission research stations are described as “addressing the social, economic and environmental aspects of sustainable forestry in a multifunctional landscape”. For British forestry the silviculture and management of all the major species for planting (many of which are exotic) have been developed and published and management technologies for all major site types for afforestation published. Current sub-themes in which much progress has been made include:

- People, trees and woodlands (developing a greater understanding of the ways in which trees benefit society and improving delivery of those benefits);
- Land regeneration and urban greening (establishing



LEFT
A scientist from the Forestry Commission's Northern Research Station in Midlothian, Scotland, takes soil measurements from the root plate of a windblown Sitka spruce tree.



- woodlands on brownfield and contaminated land);
- Woodland biodiversity (conserving and enhancing the biodiversity of forest ecosystems); and
- Woodlands and the environment (understanding the complex interactions between forests and their physical and historic environment).

The protection of trees and forests from threats such as insects and disease is an important ongoing programme.

United Kingdom – future challenges

All of the above are important within the context of climate change, which is now of overriding importance. In November 2009 the Forestry Commission presented its report *Combating climate change – a role for UK forests*, subtitled *An assessment of the potential of the UK's trees and woodlands to mitigate and adapt to climate change*. This report, believed to be the first such national study in response to the 2007 global 4th Assessment Report of the IPCC was published a month before the Copenhagen meeting of the UNFCCC (Read *et al.*, 2009).

The report was prepared by an independent panel of scientists with the following objectives:

- Review and synthesise existing knowledge on the impacts of climate change on UK trees, woodlands and forests;
- Provide a baseline of the current potential of different mitigation and adaptation actions; and
- Identify gaps and weaknesses to help determine research priorities for the next five years.

Considerable detail of priorities for future research is given; the following selective list gives an indication of some of the major identified information domains:

- Role of greenhouse gases in forest dynamics;
- Forest growth and productivity;
- Modelling for decision-making;
- Forest vulnerability;

- Carbon sequestration and stocks;
- Carbon balance of forest operations;
- Carbon accounting models for new species;
- Bioscience and energy;
- Future consumption of biomass fuel and other forest products;
- Economics of ancillary woodland benefits; and
- Limiting factors for species in use.

The Indian sub-continent

By far the greatest amount of research on the forests of the sub-continent has been carried out in the country that is now the Republic of India. Most of the generalised historical account given here is a guide also to Pakistan, Bangladesh and Sri Lanka but, notwithstanding the enormous range of agro-ecological zones in the region, both the past achievements and the challenges for the future may be considered on a regional scale. India itself is a federal country with much of its research decentralised in the states. History and achievements are considered separately for the pre- and post-Second World War periods.

History – pre-WW2

The history of Commonwealth forestry research, like that of the art and science of forestry itself, is largely based upon the practices developed in British India at a time when the country encompassed Pakistan, Bangladesh and Sri Lanka as well as the present day Republic of India. Research on forests in the Indian sub-continent followed the setting up the Indian Forest Service in 1867 under the leadership of Dr Dietrich Brandis, the first Inspector General of Forests, who was appointed in 1864. He brought with him long experience and the principles of sustained management in the forests of Saxony. Government of India research institutions were set up at Dehra Dun (Imperial Forest Research Institute and College, 1906 – now the Forest



Research Institute, FRI). Research was carried out also by silviculturists in individual states; some of these research teams were already well established before 1900.

For the first half of the 20th century the pattern of state ownership of (reserved) forests was the norm, although very large areas of private forests, notably in the self-governing Princely States (of which there were over 600 at the time of independence). Research was carried out both by specialised scientists and by professional foresters within the Forest Service. This structure was used as a model for the smaller countries of the Commonwealth, including Great Britain itself, when the Forestry Commission was established in 1919.

Initially the main concerns of forest research were: documenting the silvicultural characteristics (silvics) of indigenous trees, the sustained yield of timber (with teak in first place), the protection of watersheds and the supply of non-timber forest products. In addition to the traditional forest products and watershed protection, wildlife management was also important.

After independence, forest research in Pakistan was centred at Peshawar, in Bangladesh at Chittagong and in Sri Lanka at Kandy.

Major achievements – pre-WW2

Undoubtedly, bringing the bulk of India's forests under sustained yield management through carefully controlled Working Plans was one of the major achievements during this period, so that the forest destruction that had marked the era before the setting up of the Indian Forest Service was a thing of the past. Research and education had played a key role in this.

At the same time an enormous amount of traditional knowledge had been collated and published and many major advances in knowledge also resulted from the work of the silviculturist, forest botanists and other scientists. Many notable publications on the natural resources and timbers of India – which at that time



included Pakistan, Bangladesh, Sri Lanka and Myanmar – appeared well before 1900, the botany of the forests was well explored and forest floras and zoological treatises had been prepared. By the 1920s the silvics of all the major tree species had been studied and published (e.g. Troup, 1921), and well before the outbreak of the Second World War text books on Indian forests and their silviculture were widely published and on every forest officer's shelves. Extensive studies on properties of wood, bamboo and non-timber forest products were carried out and published.

History – post-WW2

Almost immediately after the end of the Second World War and long before recovery from the war efforts, all the countries in the region attained independence. Forest research and education, like forest administration, was now centralised in each nation. Continued steady population increase – in some cases more than an order of magnitude greater than that during the colonial

ABOVE

The latest forest policy for India subordinates direct economic benefit to environmental stability and maintaining ecological balance.

Council for Scientific and Industrial Research (CSIR) and



The CSIR's forestry research team is uniquely placed with research ranging from developing genetically improved planting stock to making use of the latest technologies for analysing wood properties and whole plantations – enabling the client to make sound economic decisions.

In South Africa, the forest, timber, pulp and paper sector contributes more than R12 billion annually, and provides some 170,000 jobs. This contribution to the South African economy can only be sustained with investment in sound research alliances and partnerships, providing a platform for the development of competent researchers and in-depth research capability.

The Forestry and Forest Products Research Centre at the CSIR works closely with the University of KwaZulu Natal, with research and development focused on understanding the fibre characteristics of timber, the properties of the raw material, how this knowledge can add value in processing operations, and how processing can be improved.

The research builds on existing world class capability, and is rendered in support of South African and global forest products companies. The primary focus lies in the optimisation of plantation forest resources grown for the pulp, paper and timber sectors, aimed at maximising fibre quality, value and uniformity of wood fibre entering processing operations. The key value addition lies in supporting companies to better understand the quality of the fibre resources that they own, or buy, and to support them in extracting maximum value from that resource. Key competencies are in wood chemical and physical properties, wood anatomy, pulp and paper manufacture,



University of KwaZulu Natal (UKZN)



remote sensing, geographic information services (GIS), and tree physiology.

This research capacity is enhanced by the tree improvement research group. Local and international stakeholders are given the opportunity to use applied tree-breeding and genetics expertise to develop their own knowledge or to acquire better trees at a faster rate. This research typically addresses the research needs of afforestation or reforestation planning and planting material supply.

Key competencies in this research area include quantitative genetics, applied tree breeding and tree improvement strategy

development, tree domestication and site-genotype matching.

According to Flic Blakeway, competency area manager for forestry at the CSIR and director of the Centre, their unique advantage is the ability to understand and apply the fact that improved wood quality and thus a better product starts at the genetic level. The different research groups are continuously complementing each other, with research and findings from the one group informing and impacting on the other.

The forestry research teams also maintain strong industry links in South Africa, Africa and abroad, with 13 industry and sector partnerships and research relationships.

For more information, please contact Felicity (Flic) Blakeway at fblakeway@csir.co.za or visit the website at http://www.csir.co.za/nre/forestry_resources/index.html.





period – put ever-increasing demands on the forest lands both for farming and forest products.

In 1989 the Indian Council of Forestry Research and Education (ICFRE) was set up to oversee forestry research in India. It comprised eight research stations (including FRI itself) in different agro-ecological zones of the country. Another positive development was the creation in many of the Indian states of Agricultural Universities, 26 of which run courses in forestry; these have now been harmonised by the adoption of a unified MSc syllabus and run in parallel with increasing amounts of forest research, particularly in sociological subjects. India, of course, has by far the largest forest sector in the region but Pakistan, Bangladesh and Sri Lanka exhibit similar trends, with centralised research and similar forest policies.

Major achievements – post-WW2

Much research on the biology and management of natural forests has continued and many exotic species introduced and studied resulting in numerous publications on recommended technologies. Forest research provided the scientific basis for many achievements. Among these are the formulation of national forest policy, the development of social forestry programmes, conservation acts restricting the transfer of forest lands to agriculture and other non-forest uses and the recognition of the rights of forest dweller. The latest forest policy for India subordinates direct economic benefit to environmental stability and maintaining ecological balance. A recent result is a wastelands reforestation programme which has been developed for large areas of degraded land.

Future challenges

The challenges facing forest research today are greater than ever before. Sociological pressures continue to build in relation to the natural and /or managed forests

in most parts of the region and Working Plans are becoming increasingly difficult to administer and implement. India has become the leader in collaborative management of state forests in partnership with local people (Joint Forest Management, described in *Chapter 2*) and many of the areas requiring research relate to changes in forest management, and to dwindling areas of productive forest. The role of NGOs and the private sector in research is increasing steadily, especially in researching the needs of rural people.

Recent initiatives in research in India focus on climate change, biodiversity conservation, bio-informatics and biotechnology. Highlights of recent achievements include strengthening of research institutions by the establishment of an India Forest Information System and creation of an advanced research centre for bamboo and rattan. ICFRE has strengthened its collaboration with UNFCCC, with which it has accredited observer status, and has an accepted proposal for carbon conservation under REDD. Important published work includes guidelines for germplasm testing and studies of carbon sinks under the Clean Development Mechanism (CDM). General research focus includes increasingly poverty alleviation and optimising the value of non-wood forest products and forest services.

■ **South-east Asia**

History

The main Commonwealth countries in South-east Asia with large areas of forest are Brunei Darussalam and Malaysia. Most forest research has been carried out in Malaysia.

Major achievements

Malaysian research on natural regeneration and the restoration of logged high forests has produced practical protocols for sustainable forest management in



several countries in the region. Research into the conversion of rubber wood and its utilisation has been a major Malaysian accomplishment, while natural forest and plantation silviculture and genetic improvement have also been studied.

Future challenges

Major forest research challenges for South-east Asia are the development of robust techniques for community forest management, and social issues. The industry on the other hand is facing challenges in raw material supply, research on substitutes and higher value added products, and the adoption of new and more efficient technologies. The impacts of climate change are an increasingly important area of research, especially in coastal areas.

■ **The Pacific Islands (Australasia/Oceania)**

The countries in the region are mostly islands including Papua New Guinea, Fiji and the Solomon Islands.

History

Most of the rain forests have been logged.

Research achievements

Research achievements include the development of protocols for management and restoration of these forests or advanced plantation technologies.

Future challenges

Maximising the effectiveness of what are in most cases very small research scientist cadres will continue to be a high priority. Developing management protocols for sustainable forestry together with realistic certification will also be important. For the low-lying islands in particular social and ecological issues resulting from climate changes, notably sea level rises and tsunamis, are likely to be the most important of all.

■ **The Caribbean and South America**

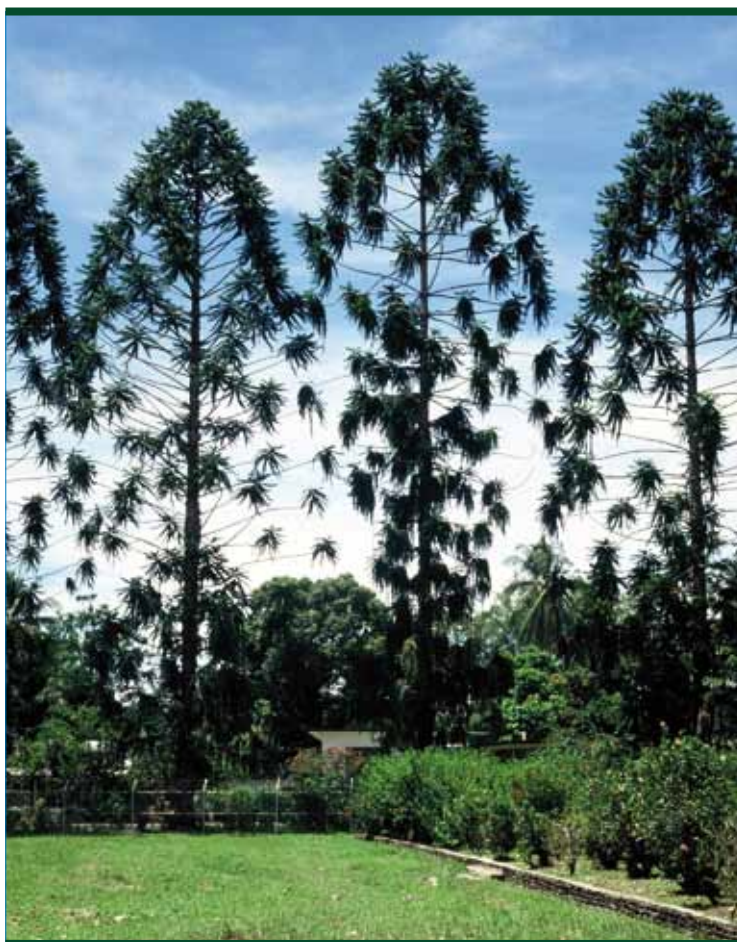
The Commonwealth countries of the region are mostly small islands with small areas of forest; exceptions are Guyana (for a description of Iwokrama Forest see *Chapter 2*) and Belize.

History

All the countries have small professional forestry cadres and few researchers. Most of the natural forests have been logged, but good progress has been made on regeneration methods and plantation technology. Forestry activity is, however, on a small scale and commonly concerned with the conservation of biological

BELOW

Araucaria sp. on the campus of the Papua New Guinea Forest Research Institute.





diversity, amenity (often in support of tourism) and small-scale plantations.

Research achievements

Research on plantations and natural forest regeneration has produced some valuable guidance on forest management. Forest botany and silvics of important species have been partially studied.

Future challenges

For most of the countries in the region the main future importance of research will be on effects of climate change on ecosystems and human settlement.

Support to Commonwealth forest research

A number of developed Commonwealth countries have assisted less-developed countries with forest research since those countries attained independence from the UK. Australia, Canada, New Zealand and the UK have supported numerous research projects, many of which are still ongoing, in the whole of sub-Saharan Africa, parts of the Indian sub-continent, Papua New Guinea and the Caribbean and the Pacific islands. Technical assistance through research training and the provision of specialised research personnel has also been funded between Commonwealth countries.

Canada has allocated more than C\$65 million in funding for a new research programme to help the poorest adapt to climate change. The Department for International Development (DFID) of the UK supported a Forest Research Programme (FRP) for developing countries (many of which are Commonwealth) from 1990 to 2006.

Summary

Forest research has a long tradition in the Commonwealth, based as it has been for decades on the essential need for scientific investigation in support of

forest management and conservation. Many countries, within and outside the Commonwealth, owe a considerable debt to the experience of India in establishing forest research within the official forest service.

Much work has been done on the development of techniques for tropical plantations at high altitudes and for tropical lowland forest management, although more remains to be done, and dry formations are less well investigated. The matching of species and provenances to site, and tree improvement work, has led to remarkable advances in plantation technologies and productivity throughout the Commonwealth; an example of a new priority is the need for hardwood plantations for high value veneer logs. Work on timber properties has led to the utilisation of many previously unused species, a particular example being the development of conversion techniques for rubber wood leading to the development of a major wood-working industry in Malaysia and elsewhere. Future research work will relate to tree breeding for improved recovery of wood and fibre.

Although much has been done through participatory research to develop methodologies for the involvement of civil society in the management of public forests the application still has some way to go. India's Joint Forest Management initiatives are positive examples. Research is also still needed to increase the role of forestry in poverty reduction and to optimise the contribution of agroforestry and trees on farms in rural economies

But more intensive management of both natural and planted forest is leading to greater risks from insect pests and disease outbreaks (discussed in relation to management in *Chapter 2*) and protection will constitute a priority for forest research in future.

Above all, however, all countries, whether developed or developing, tropical, temperate or boreal, emphasise the need for research into the impact on forests of climate change. Priorities will include such topics as the mitigation of ecological effects of climate change,



adaptation of species, provenances and ecosystems to drought, maintaining forest biological diversity, the effect of forest management practices on water catchment yields, fire prevention and control, detection and control of pests and diseases and of invasive species.

Other new directions will include social research related to the growth of urban populations with little appreciation of countryside issues, such as fire hazard, and other urban forestry issues such as tree planting for site amelioration on polluted sites.

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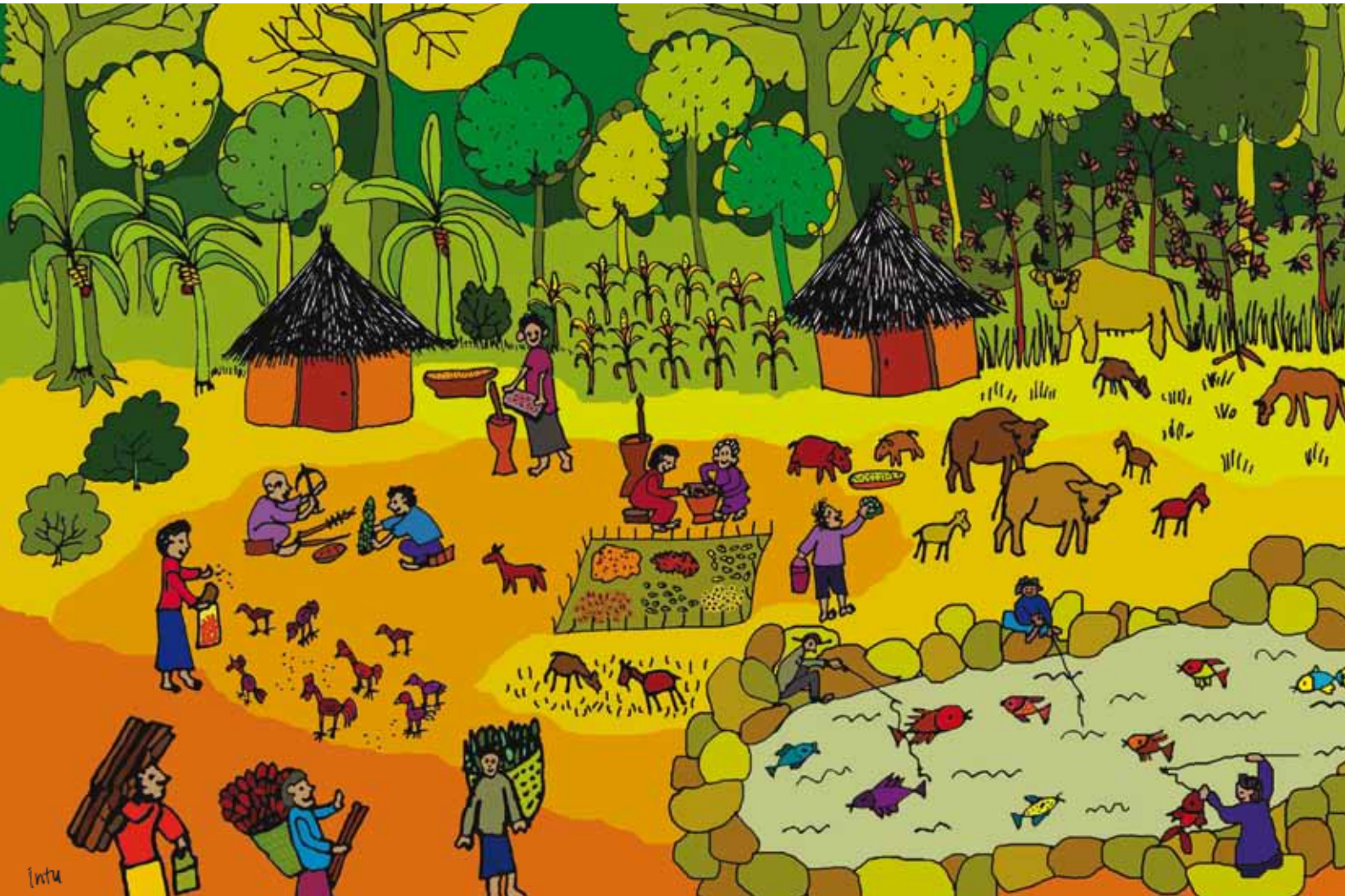
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What if...



LIVELIHOODS AND LANDSCAPES STRATEGY

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Two-thirds of the earth's original forest cover has been lost.

More than three quarters of the world's forests are lost or degraded.

Only about one fifth remains relatively undisturbed.

In the decade between 1990-2000 the world lost about 0.22% of its forest each year, and then 0.18% between 2000-2005. While some Commonwealth countries (e.g. India, New Zealand, UK, Swaziland and The Gambia) showed a net increase in forest area, overall there has been a loss of forest in Commonwealth countries in recent years. The annual area of forest lost has grown, from 0.27% yearly in 1990-2000 to 0.31% yearly in 2000-2005, a rate of loss nearly twice as fast as the rest of the world.¹

The continuing global loss and degradation of forests requires urgent action. Measures to tackle deforestation are high up the

political agenda but we can also restore currently degraded forests at the same time, effectively protecting what we have left while bringing back some of what we've lost. As Truman Young² argues, it's about a mindset that is not just dominated by combating loss in the short-term, but also about promoting recovery in the long-term.

This is important for our future, and the future of our planet. With a global population already approaching 7 billion, and forecast to increase to more than 8 billion by 2025, the pressure on all of our natural resources is immense. But the area of forest continues to shrink and what's left is increasingly degraded. With this comes the loss of the forest goods and services that we all depend on, like a secure supply of clean water, wood for fuel and timber, and habitat for wildlife.

Of course, not all converted or degraded forests are suitable for restoration. Some of the world's most productive agricultural lands were once forests and will remain in agriculture, as will urban and industrial areas that were previously covered by forest. However, vast areas that are only marginally productive could grow

trees once more, and those trees could perform many functions and meet multiple demands.

A recent study for the Global Partnership on Forest Landscape Restoration estimated that more than 1 billion hectares of lost forests and degraded lands are suitable and available for restoration (<http://www.ideastransformlandscapes.org/>). This is equivalent to an area the size of Canada.

These are the landscapes of opportunity.

The global carbon sequestration potential of restoration of this area has been estimated conservatively as at least 70Gt carbon, comparable to that from avoided deforestation – so the two strategies must go hand in hand.

Even though the December 2009 Copenhagen climate change summit was not as successful as had been hoped, it did result in detailed negotiations on a mechanism on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD). Within this a major shift in thinking was seen from a narrow focus on avoided deforestation to a broader approach to REDD that encompasses the “plus” – including the role of restoration in enhancing forest carbon stocks, as well as

¹ Commonwealth Forestry Association (2007). Commonwealth Forests: An overview of the Commonwealth's forest resources.

² Young, T. P. (2000). "Restoration ecology and conservation biology." *Biological Conservation* 92: 78-83.

conservation and the sustainable management of forests. A REDD-plus mechanism has the potential to catalyse unprecedented support for forest restoration.

The good news is that forests can and do recover. People around the world, including in many Commonwealth countries, are restoring forest landscapes in different ways and for multiple purposes, such as:

- Climate change mitigation through carbon sequestration
- Contributions to rural livelihoods and better access to firewood
- Increased food security
- Security and quality of the water supply
- Reduced risk of flooding and mud slides
- Biodiversity conservation, and
- Production of forest products to serve markets near and far.

Fortunately, there are countless examples of successful landscape restoration around the world, from Australia to India, Ghana, Uganda and the United Kingdom, amongst many others.

For years the indigenous Benet People living around Mount Elgon National Park in Uganda have suffered the effects of marginalisation and severe landscape degradation that have impacted on their forests' capacity to deliver their

livelihood needs. With IUCN support, communities have identified barriers to landscape restoration, one of the most important being uncontrolled livestock grazing. By developing a community land management by-law, more than 20 km of contours have been planted and 1000 ha of Benet landscape has been restored. This has created a more productive landscape in which agriculture and non-timber forest products can make better contributions to livelihoods. At the same time, pressure on the resources within the National Park area is now under better control.

In the Indian state of Orissa in the buffer zone of the Simlipal Tiger reserve, long-term restoration of the forest-agriculture matrix has been based not on planting trees, but on changing governance structures. Institutional development is the key to the whole process in the landscape and Winrock International India and IUCN have assisted community groups in their application of participatory resource management principles. This helps ensure that the benefits of non-timber forest products are more equitably shared and provide incentives for villagers to better manage and enhance areas of woodland. The

Orissa Forest Department has been supportive and with their help drives for awareness building for bio-diversity conservation, forest protection and livelihood enhancement have become routine. Joint Forest Management committees and other forest protection groups have been integrated up to the district level, giving the groups more influence over the decisions that affect them. Increasingly the village Joint Forest Management committees now look beyond the forest, seeing management of the broader landscape as the goal.

So, we can do it. We can restore the balance between man and nature in forest landscapes. Experiences around the world show this. But it isn't happening on the scale that's needed.

Our challenge together is to do what needs to be done to turn today's loss into tomorrow's gain.

Carole Saint-Laurent, Senior Forest Policy Advisor, IUCN & Coordinator, Global Partnership on Forest Landscape Restoration.

James Gordon, Livelihoods and Landscapers Strategy, IUCN (www.iucn.org/forest).