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The Contribution of Australian and International Forestry Research

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Paper prepared for presentation at the “Forests, Wood And Livelihoods: Finding A Future For All” conference conducted by the Crawford Fund for International Agricultural Research, Parliament House, Canberra, Australia, 16 August 2005

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SESSION: FINDING A FUTURE FOR ALL

The Contribution of Australian and International Forestry Research

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Forests are making major contributions to rural livelihoods in Australia and in many other countries of the Asia-Pacific region. These include direct economic returns from the harvest of both timber and non-timber forest products, and indirect contributions to other economic activity through effects on soil and water quality.

Research and development has provided the foundation upon which the forestry successes of Australia and its neighbours have been based, and international collaboration has been a major plank. ACIAR's collaborative research program has made a significant contribution. A suite of plantation eucalypt projects has contributed to the development of a major industry in southern China, and the skills and experience so acquired have undoubtedly contributed also to the success of Australia's recent bluegum plantation program. A collaborative approach to evaluating and monitoring pests and diseases of Australian species is contributing to the protection of forests in all countries of the region.

Although there have been successes, the contribution that forests make to rural livelihoods is under threat. A new array of challenges must now be met, and it is these that ACIAR's forestry program seeks to address. Emphases include the better management of native forests, improving the

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management of plantations, developing and promoting agroforestry systems that integrate tree planting with other agricultural activities, ensuring that industry development is compatible with community capacity and desires and with local and international market expectations, and promoting the equitable distribution of benefits. International collaboration on these issues of common concern is fundamental to the attainment of a shared vision.

Introduction

Forestry is a significant contributor to the livelihoods of Australians, and a major component of rural livelihoods in many countries of the Asia-Pacific region. Australia's forest product industries have a turnover of A\$15 billion annually, and contribute A\$2.1 billion annually in export earnings. The management of Australian forests for a range of other major economic and non-economic values is also of vital importance to Australian society.

Forests provide major economic benefits also to many of Australia's Asia-Pacific neighbours. Harvests of timber from native forests make major contributions to the economies of Papua New Guinea, Solomon Islands and Indonesia for example. There have been major expansions of plantation areas in China, Indonesia and Vietnam. In many countries of the region, forests are fundamental to community livelihoods, and non-timber forest products, from native forests and agroforestry, make a vital contribution to rural economies, for example in Laos, Indonesia and many Pacific Island nations.

In all of these countries, including Australia, the sound management of forests for their multiple

values is impossible to separate from other economic activities — e.g. livestock, agricultural crops and fisheries. Forestry is a fundamental activity — the sustainable management of the forested environment underpins the maintenance of economic contributions of other elements of rural livelihoods.

In all of these countries, the sustainability of forest management is a significant challenge. Many native forests are being harvested at an unsustainable rate, jeopardising future economic returns from these forests as well as generating serious soil and water quality issues that will affect other contributions to livelihoods. The expanding plantation programs face many issues — optimising product values and recoveries, sustaining productivity over rotations, developing improved genotypes, matching genotypes to sites, and protection from pests and diseases.

Australian forestry has a long tradition of basing forest management upon a sound platform of forest science, and Australian forest research agencies, in particular within CSIRO, state departments and the universities, have made excellent contributions. Silvicultural management of native forests has been based upon ecological and yield studies. Strong silvicultural, genetic and utilisation R&D programs have underpinned the success of Australian plantations. This has included domestication of indigenous *Araucaria cunninghamii* and *Eucalyptus globulus*.

Australian forestry has depended heavily upon international collaboration — exotic species, in particular from north and central America, remain the major component of our plantation programs. For at least the last 25 years, Australian forest research agencies have also been actively involved in collaborative research programs in the Asia-Pacific region. ACIAR has been a strong supporter of these programs, providing funding for collaborative projects between Australian research agencies and research agencies in developing countries. This account reviews some of the achievements of these collaborative programs in forest research, and assesses future priorities.

Contributions of ACIAR's forestry program

Established in 1982, ACIAR is an Australian Government statutory authority that operates as part of Australia's Aid Program within the port-

folio of Foreign Affairs and Trade. It contributes to the aid program objectives of advancing Australia's national interest through poverty reduction and sustainable development. ACIAR's special charter is the development of collaborative research projects, of mutual interest, to which partner agencies in both Australia and in the relevant developing country contribute.

ACIAR's Forestry program, one of eleven programs, contributes to poverty alleviation and natural resource conservation and rehabilitation through scientific support for the establishment, management and sustainable utilisation of forests, providing optimum social, economic and environmental benefits to partner countries and Australia. The program has developed projects in many countries, including China, Vietnam, Laos, Malaysia, Thailand, India, South Africa, Kenya, Zimbabwe, Indonesia, Philippines, Papua New Guinea, Fiji, Tonga, Samoa, Vanuatu and Solomon Islands. Highlights of the program include:

Eucalypts in southern China

ACIAR has been actively involved in projects in China since 1985, building upon a foundation provided by the AusAID-funded Dongmen State Forest Farm project that commenced in Guangxi Province in 1981. The seven ACIAR projects focused on genetic improvement and silviculture of plantation eucalypts. Prior to the Australian involvement, southern China had extensive areas of relatively unproductive eucalypt plantations. There is now a vibrant eucalypt plantation industry in southern China, based on eucalypts that are almost three times as productive as those planted earlier. The impacts of the Australian work were reviewed recently by van Bueren (2004b), who estimated an NPV of AU\$1.3 billion and an Internal Rate of Return of 40%. This work was conducted collaboratively by several Chinese and Australian forest research organisations, and represents the collective effort of most Australian and Chinese eucalypt plantation research capability. The R&D programs have contributed directly to the improvement of rural livelihoods in southern China. Pulp and paperboard manufacturers are providing off-farm employment for large numbers of Chinese workers, and rural households have increasingly turned to short-rotation eucalypts as an alternative to traditional cash crops. The eucalypt growing and processing industries have contributed significantly to greatly improved infrastructure and prosperity in southern China.

Almost all of Australia's own eucalypt plantation estate of around 700 000 ha has been established during the past two decades. The skills and experience acquired collaboratively in China have undoubtedly contributed to the success of this new industry.

Acacia hybrids in Vietnam

From 1998 to 1992, ACIAR supported a project on 'Hybridisation and vegetative propagation of Australian tropical acacias'. Partners collaborating on the project included CSIRO, the Forest Research Institute of Malaysia and Sabah Softwoods, a commercial grower of acacias. The project developed methods for breeding and propagating acacia hybrids. While Malaysia was the targeted beneficiary of the work, Vietnamese scientists monitored the work and utilised the results in Vietnamese hybrid acacia programs, which were supported in part by ACIAR and a range of other agencies. Vietnam now has a rapidly expanding industry based on hybrid acacias. The impacts of this work were reviewed by Van Bueren (2004a), who concluded that the commercial release of acacia hybrid clones in Vietnam had been brought forward by four years as a result of the ACIAR work in Malaysia. The NPV of this acceleration was estimated at AU\$152 million, and the benefit:cost ratio of ACIAR's research investment at 145:1. Acacia hybrids are highly productive in Vietnam, and the industry based on these has the potential to provide both on- and off-farm income in areas to which they are suited.

Tropical pests and diseases

ACIAR has supported a variety of projects focused on minimising impact of forest pests and diseases. In particular, these have included several projects characterising the fungal pathogens and insects of eucalypts and acacias in Southeast Asia, and evaluating their impacts. Of particular significance has been work evaluating the susceptibility of eucalypts to guava rust (*Puccinia psidii*), the preparation of risk analyses and hazard maps, and the development of molecular diagnostic techniques for the detection of the pathogen. This pathogen, currently restricted to Florida, the Caribbean and Central and South America, would have a devastating impact if it became established in Australia or our neighbouring countries of the Asia-Pacific region. Other projects have focused on heartrot of acacias, and other pathogens and insect pests of Australian tree species. Another important element of this work has been the de-

velopment of forest health surveillance systems for Pacific Island countries. This project has resulted in the identification of major pest and disease threats to forests in the region, the development of approaches specifically tailored to the countries involved, and the establishment of small forest health surveillance units in each.

As a result of this body of collaborative work, there is an increased knowledge of threats to Australian forest species, and a heightened level of shared vigilance. This work essentially comprises a 'neighbourhood watch' approach to the management of serious pests and diseases of forests, an approach that is as beneficial to Australia as it is to our partner countries.

Development of leucaena hybrids

From 1995 to 2000, ACIAR supported a project aimed at developing and promoting improved leucaena varieties for use in PNG, Philippines, Vietnam and Australia. Key collaborators on the project have been the University of Queensland, CSIRO, Queensland Department of Primary Industries, Lae University of Technology, Rural Development Bank of PNG, Philippines Bureau of Animal Industry, Hanoi University of Science, and CIAT. The extent to which the results of this project have been adopted was recently reviewed by the project leader (Shelton 2005). This has been a highly successful project. Leucaena-based grazing systems developed in PNG have been highly productive, with the new cultivar released during the project now being planted on a large scale by a large commercial operator, significantly raising the potential for ruminant production. A more significant impact on rural incomes will eventuate if these systems are adopted by PNG smallholders. In the Philippines, where there is a long tradition of using leucaena to feed livestock, uptake of an improved hybrid that is both highly productive and insect resistant has improved livelihoods for several hundred farmers. These improved cultivars are also now being utilised by several hundred Vietnamese smallholders, with significant potential livelihood benefits.

This ACIAR-funded project has contributed significantly to the development of leucaena grazing systems in Australia, and to economic benefits arising from adoption of these systems. Leucaena systems are now in use by about 400 graziers with over 100 000 ha fattening around 100 000 cattle annually in northern Australia.

Development of wood-cement composites for low-cost housing

A project conducted collaboratively between the Australian National University and the Forest Products Research and Development Institute of the Philippines developed methods for the production of wood-wool cement boards using acacias. Development of better wood-wool cement boards for the building industry in the Philippines holds promise for rapidly assembled, robust and attractive houses to fill the urgent need for shelter. A number of companies are manufacturing the boards in the Philippines, and one company has developed an emergency shelter potentially resilient to earthquakes. This work has attracted attention also in Kenya and South Africa, with manufacturers of low-cost housing in those countries requesting details of the technologies developed.

The new frontier of R&D challenges for livelihood enhancement

A positive vision for the future of forestry in Australia and its Asia-Pacific neighbours could include:

- the ongoing management of native forests for the sustainable production of timber, non-timber forest products, and other values
- a vibrant plantation sector, growing both pulpwood and solid-wood products
- a strong agroforestry sector, involving smallholders and larger-scale farmers growing trees in systems involving integration with the production of other crops and livestock. In Australia, this could include widespread tree planting to ameliorate adverse environmental impacts of agriculture, for example in coastal north Queensland or in areas susceptible to dryland salinity, with the trees also potentially supplying other products. In Laos or PNG, for example, this could involve the planting of teak and other high-value species, integrated with other crops. In some countries, such systems could replace those currently based on shifting agriculture.
- strong local economies based on trade in forest products, plus international trade based on competitive advantage and featuring regional cooperation.

- local value-adding where appropriate and feasible, e.g. portable sawmilling in PNG and other Pacific countries.

There are many challenges to the attainment of this vision. Native forests need to be more widely regarded as capital assets that, managed appropriately, can provide an ongoing stream of forest products while also underpinning sustainable agriculture and fisheries. Plantations need to be appropriately sited and optimally managed to supply products of the required quality. Agroforestry systems similarly need to be managed efficiently and effectively.

Many of the challenges will require changes in policy, governance and community attitudes. Some of the challenges, however, are amenable to R&D solutions, and it is these challenges that ACIAR seeks to address. Current thrusts of ACIAR's program include:

a. The development of silvicultural methods for promising high-value and multipurpose species

ACIAR's forestry program has traditionally had a major focus on developing improved forest tree germplasm, and this continues, but with a particular emphasis on delivery of improved material — through development of seed orchards, seed production areas and cuttings orchards — of species such as *Dracontomelon dao* and *Calophyllum europhyllum*, and the development of community-based training programs in propagation and silviculture. This work with species valued for their timber is complemented by work with multipurpose trees such as *Canarium*. The nuts of this tree contribute significantly to local economies in PNG, Solomon Islands and Vanuatu, and show potential as an export commodity. There is an escalating interest, particularly by smallholders, in growing the trees commercially. Work now under development will identify, propagate and distribute cultivars displaying higher productivity and product quality. Optimum silvicultural methods will also be developed for *Endospermum medullosum*, showing promise as a plantation species in Vanuatu and elsewhere in the Pacific. These projects are being conducted collaboratively between agencies in Australia and the Pacific countries mentioned.

b. Value adding

The development of approaches that will provide greater returns from existing resources or programs is an important current emphasis. An excellent example concerns the growth stress work underway for plantation eucalypts. There is now considerable interest internationally in the production of solid wood products from plantation eucalypts, as natural forest sources of such products become more limited. However, growth stresses in young plantation-grown eucalypts represent a major impediment to economically viable recovery of solid-wood products. The release of growth stresses on felling and sawing results in splitting and distortion that greatly reduces recovery of high-grade sawn products or veneer, and plantation eucalypts have acquired a reputation for being difficult to convert to high-value products. ACIAR is managing a suite of projects broadly aimed at understanding the nature and causes of growth stresses in eucalypts, and at providing practical solutions to the problem. These projects have been, or are being conducted, as partnerships between relevant forestry agencies in Australia, China and Vietnam.

Another project under consideration is directed at developing a larger niche for coconut wood in the international high-value flooring market. While the global demand for timber flooring is large and increasing, the supply of suitable hardwood is decreasing, due to diminishing resources. Appropriately selected and processed, coconut wood has the capacity to make an excellent parquet flooring product. This work aims to determine the physical and mechanical properties that will underpin acceptance of coconut wood in this market, to optimise flooring design profiles, and to develop primary and secondary processing techniques, grading standards, product specifications and appropriate quality control systems.

The processing of indigenous nuts and other non-timber forest products is also a target for ACIAR's forestry program.

c. Development of agroforestry systems

The development of agroforestry systems that will deliver both short- and long-term economic returns through the improved production of timber and non-timber forest products, and through returns from crop and livestock elements, is an im-

portant focus of ACIAR's forestry program. Work under development will target systems to improve the production of teak and other high-value timber species, while also improving the productivity of interplanted crops such as paper mulberry, cinnamon, rattan and others, significantly increasing rural income in areas of Laos, Indonesia and other countries of the region. This work recognises that non-timber forest products are an important contributor to rural economies in several of these countries. Supply of such products is commonly based on unsustainable practices, and the development and adoption of suitable agroforestry systems is likely to contribute strongly to sustainability. Included will be work on selection and appropriate deployment of genetically improved varieties.

d. Addressing the socio-economic dimensions

Socio-economic issues pose significant impediments to improving the contribution of forestry to rural incomes, in Australia as well as in ACIAR's partner countries, and this is an important focus of ACIAR's forestry program. In Papua New Guinea, for example, work is underway to identify and characterise the key issues impeding the development of a viable industry based on high-value timber species grown in agroforestry systems. Essentially this work aims to define the connection between an existing market for sustainably-produced high-value timber, and the inherent capacity of Papua New Guineans to grow trees in agroforestry systems. It will characterise both the biophysical and farmer-decision elements of PNG agroforestry systems relevant to incorporation of high-value tree species, and the relevant policy contexts and issues, and will identify barriers to adoption that can be addressed by research or other approaches.

Other work is examining forestry out-grower schemes, which increasingly are being used in Indonesia, Australia and elsewhere to link small-scale growers and timber processing companies, as companies with inadequate forest holdings or limited access to public forests seek to secure additional supplies to meet the increasing global demand for wood products. However, not all out-grower partnerships are viewed as successful: poor grower-industry links are regularly identified as one of the major constraints to forestry development throughout the world, such as when growers emerge as price takers in monopoly mar-

kets. The ACIAR work is examining existing forestry partnerships in both Australia and Indonesia in order to define the essential characteristics that will increase the viability of forestry and improve rural livelihoods. Smallholder finance schemes are another area of interest, as is the marketing of indigenous nuts and other non-timber forest products.

Conclusions

Forests are making major contributions to rural livelihoods in Australia and in many other countries of the Asia-Pacific region. These contributions include direct economic returns from the harvest of both timber and non-timber forest products. In some countries, returns from the harvest of timber comprise a major component of the national economy. Forests also contribute less directly to rural livelihoods. Many communities live in or near forests, and forests provide living environments.

The contribution that forests make to rural livelihoods is being threatened on a number of fronts. Both timber and non-timber forest products from natural forests in many countries of the region are being harvested at a highly unsustainable rate, and livelihoods based on these are inevitably threatened. A major impact on national economies must be anticipated in countries where timber is a major export earner. Removal and degradation of forests is causing damage to soil and water quality that will adversely affect agriculture and fisheries.

Many of these issues are common, to a greater or lesser extent, to most countries of the region. However, good solutions are available, and it is possible to hold a very positive vision for Asia-Pacific forestry, where forests provide an even larger contribution to rural livelihoods and national economies than is currently the case, while

also providing more intangible values, and sustaining other livelihood activities based upon soil and water resources. The solutions are to do, for example, with better management of native forests, improving the management of plantations, developing and adopting agroforestry systems that integrate tree planting with other agricultural activities, ensuring that industry development is compatible with community capacity and desires and with local and international market expectations, and ensuring that benefits are equitably distributed. In many ways this is a shared vision, with countries increasingly linked economically, environmentally and politically. The attainment of the vision will require action by governments, NGOs, communities and individuals. R&D will continue to provide the foundation upon which sound forest management will be based. International collaboration on issues of common concern is fundamental, and ACIAR's forestry program will continue to make a crucial contribution to Australia's R&D collaboration with its Asia-Pacific neighbours, and to the attainment of a shared vision.

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