Annals of Tropical Research 25(2): 65-75 (2003)

Rainforest Reforestation and Biodiversity Benefits: A Case Study from the Australian Wet Tropics

Robert Harrison[1], Grant Wardell-Johnson[2] and Clive McAlpine[1]

[1] School of Geography, Planning and Architecture, The University of Queensland, Brisbane, Qld 4072, Australia
[2]School of Natural and Rural Systems Management, The University of Queensland, Gatton, Qld 4343, Australia

ABSTRACT

This paper examines the effectiveness of a rainforest reforestation program (the Community Rainforest Reforestation Program in north-eastern Queensland, Australia) in providing amenity and biodiversity benefits. This program involved small areas of mainly mixed native timber species on private farmland. Government support was provided for the program, for both timber production and environmental reasons. Survey results reveal that landholders have planted trees, and intend to manage plantations, for diverse reasons, including conservation purposes. The plantings appear to be of environmental value, forming wildlife corridors and buffer areas. In this respect, the CRRP has achieved a limited success in meeting the implicit goal of biological conservation.

Keywords: biodiversity restoration; fragmented vegetation; community reforestation; landholder survey; wildlife population changes.

INTRODUCTION

The restoration of biodiversity values is prominent in objectives for reforestation in extensively cleared landscapes (Wardell-Johnson *et al.*, 2002; Catterall *et al.* in press; Tucker *et al.* in press). Farm and community forestry can play a role in biodiversity conservation by establishing and linking existing corridors and patches of remnant forest. However, plantings may need to be large scale and be in close proximity, to achieve significant biodiversity benefit at a landscape scale. In addition, they usually require considerable management intervention, particularly during the early phases of establishment and growth (Tucker *et al.*, in press).

The Wet Tropics Bioregion (bioregions *sensu* Thackway and Cresswell, 1994) includes over 18,000 km^2 in north-eastern Queensland. Two thirds of the area is tropical rainforest, comprising the most extensive rainforest tracts

remaining in Australia. The biota of the area are characterized by particularly high levels of diversity and endemism (Lane and McDonald, 2000), and these remnants are recognized as internationally important refugia for many rare and threatened taxa (Turton and Freiburger, 1997).

While the more mountainous areas of the Wet Tropics include large continuous tracts of rainforest, it also abuts and includes the extensively modified agricultural landscapes of the Atherton Tableland. The remnant vegetation of this area is now highly fragmented, and is scattered over approximately 900 km^2 (Crome and Bentrupperbaumer, 1993), and embedded in a landscape matrix of agriculture and expanding urban settlements.

Considerable land-use policy change, together with profound social change, occurred in the Wet Tropics Bioregion during the last four decades of the 20th Century. Of special significance was the listing by the Commonwealth Government of the Wet Tropics of Queensland World Heritage Area (WTWHA) in 1988. This listing was the culmination of protracted and divisive debate between the three tiers of government and several interest and stakeholder groups.

The Community Rainforest Reforestation Program (CRRP) was one of several tree-planting schemes introduced around the time of the listing of the WTWHA, at least partly to offset the local social costs predicted as a result of this listing (Lamb *et al.*, 1997). The CRRP involved many small-area plantings, of a range of species including local cabinet timber species. Biodiversity conservation was not one of the four stated goals of this program. However, many of the plantings were along watercourses and adjoining native forest, areas long recognized for their importance in biodiversity conservation (e.g. Wardell-Johnson and Williams, 1996). This paper examines the contribution of the CRRP to vegetation corridors to enhance biodiversity conservation in the Atherton Tableland in north-eastern Queensland.

DEFORESTATION, FOREST FRAGMENTATION AND CONSEQUENT CONSERVATION MEASURES

The forest industry in north-eastern Queensland began with the earliest European exploration and settlement of the region. Operations of the cedar-getters began in the coastal rainforests near Cairns in the 1880s, and in the even richer rainforests of the Atherton Tablelands shortly afterwards (Carron, 1993). Early operations were directed primarily at Red Cedar (*Toona ciliata*) and the conifers Hoop Pine (*Araucaria cunninghamii*) and Kauri Pine (*Agathis robusta*). However, exploitation was limited in scale by the dependence upon bullock teams for log extraction and upon primitive milling plants. Logging of Tableland forests began in earnest about 1909 and proceeded rapidly for the next three decades. With increasing mechanization in the period following World War 1, the industry expanded but was soon adversely affected by the depression of the late 1920s and early 1930s. The early establishment of plantations of Hoop and

Kauri Pine were a response through relief payments for the unemployed at this time.

The forest industry in north Queensland rainforests reached its zenith in annual harvest volume and milling facilities immediately following World War 2, with the timber cut reaching a peak of 350,000 m^3 per annum. The demand for new housing and land for settlement were both extremely strong. Government policies favoured both an expanded forest industry, and more forest clearing (Lamb *et al.*, 2001). In the mid 1980s the allowable cut was set at 80,000 m^3 per annum, later reduced to about 60,000 m^3 per annum, as a sustained yield requirement imposed by State Government (Vanclay, 1996).

On the Atherton Tableland, large areas of rainforest were cleared for agricultural crops and dairying. Almost all the available land had been cleared by the 1970s. By 1983 over 76,000 ha of forest had been removed, leaving about 100 forest remnants ranging from one to 600 ha in area, scattered over an area of approximately 900 km^2 (Winter *et al.*, 1987; Laurance, 1997; Turton and Freiburger, 1997), mostly surrounded by cattle pastures.

The use of North Queensland rainforests for timber production became a controversial environmental issue from the early 1960s, with calls for conservation of particular areas becoming increasingly frequent in the 1970s (Carron, 1993; Adam, 1994). The Wet Tropics occupied a central position in national environmental politics throughout the 1980s (Doyle, 2000). Issues focused on the debate between the conservation of native forests, and traditional forestry practices, and questions of State and Federal rights. The Commonwealth Government nominated the forests of the Wet Tropics for World Heritage listing in December 1987, despite vehement opposition from the Queensland Government and local government authorities. Protracted and bitter conflict between conservationists and the pro-logging group remained (Lynch, 2000).

The area was inscribed on the World Heritage List in 1988 for its exceptional natural values, satisfying all four criteria for inclusion as a "natural heritage":

- outstanding examples representing the major stages of the earth's evolutionary history;
- outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial and fresh water ecosystems and communities of plants and animals;
- superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance; and
- the most important and significant habitats for *in situ* conservation of biological diversity, including those containing threatened species of plants and animals of outstanding universal value from the point of view of science and conservation.

In terms of management planning, the Wet Tropics represents a major challenge. The area is both large and highly fragmented, encompassing several

non-contiguous parcels of land. A variety of tenures are present, including National Parks, State Forests, and Vacant Crown Lands as well as leasehold and freehold properties (Wet Tropics Management Authority, 1997). Management is further complicated by the need to take into account the views of all three levels of government – Commonwealth, State and several Local Government Authorities (LGAs) – as well as local community groups, including the indigenous population.

The potential for the effective conservation of Queensland's biodiversity is limited within the National Park system (Brooks *et al.*, 1999). This is partly because of the tendency for small remnants (<20 ha) within these parks to support only a subset of the total biodiversity (Laurance, 1997; Catterall *et al.*, in press). Another reason is that National Parks tended to be declared on lands not suitable for agriculture and often not containing a comprehensive, adequate or representative (CAR) sample of the regional diversity. Thus, many forest-interior species are found only in large forest tracts. On the Atherton Tableland for example, small reserves often fail to conserve golden bowerbirds, rufous owls, lesser sooty owls, Australian fernwrens, chowchillas and Southern Cassowaries (Warburton, 1997). This situation is likely to be similar for many of the species that inhabit the WTWHA.

The effective management of the many parks, which often are too small to be viable for all biota, requires the management of the whole landscape in which they are embedded (Sattler, 1993; Laurance, 1997). Efforts to maintain and extend the World Heritage Area continue. The Government funded Daintree Rescue Package is buying back private properties adjoining the World Heritage Area, which are now considered inappropriate land subdivision.

Restoration plantings are a means to enhance biodiversity conservation in fragmented agricultural landscapes to form corridors and networks to link remnants of high conservation value. This requires an examination of the distribution of remnant patches, an inventory of the associated biota and the setting of priorities for developing a conservation network to avoid further loss of biodiversity. It is likely to be essential that such efforts are locally driven by those with the greatest stake in the results of such work.

THE COMMUNITY RAINFOREST REFORESTATION PROGRAM

A variety of reforestation activities have been carried out in the Queensland Wet Tropics following World Heritage listing, both in the protected area and on farmland. Most notable of these has been the Community Rainforest Reforestation Program (CRRP), which arose from the structural adjustment package that followed the logging ban in the WTWHA and commenced in 1992. This program was managed by a committee representing all three levels of government – Federal, State and 14 local government units.

The stated goals of the CRRP were to develop a private plantation timber resource, arrest land degradation following inappropriate clearing, improve water

quality in rivers and streams, and train a workforce to support rainforest plantation establishment (CRRP Management Committee, 1993). There also were implicit goals related to other expected non-timber benefits of forests. This program represented one of the first attempts by governments to meet such a broad range of objectives, albeit with a primary focus on farm forestry. This approach was partly adopted to attract those landholders with interests in tree planting for reasons other than timber production. About 2000 ha of mainly mixed native species were established over about 400 farms during the period 1992 and 1998 (CRRP Management Committee, 1995; 1998), after which little further planting took place.

THE LANDHOLDER SURVEY: METHOD AND FINDINGS

A survey was conducted of CRRP landholders who lived in Atherton and Eacham Shires, during the periods 8th to the 17th of December 2000, and 8th to the 25th of January 2001 (Harrison, 2001). Two local government areas (the Atherton and Eacham Shires) contained an aggregate area of 430 ha planted under the CRRP. The total sample size was 72 landholders, a response rate of just under 50%. The aim of this study was to examine the extent to which the CRRP has achieved its stated goals and also its implicit goals. The survey data were analyzed using a MicroSoft Excel spreadsheet, and various frequency distributions, cross-tabulations and graphs were produced and interpreted. The Statistical Package for the Social Sciences (SPSS) was used to perform chi-squared tests and one-way analysis of variance on the survey data, where appropriate.

Tree Planting Activity

All respondents had planted under the CRRP. The majority of the plantings were small: Thirty four percent had planted less than 3 ha, and 24% between 3 and 10 ha. The median area was 3.5 ha, the mean 6.05 ha and the maximum 45 ha. Seventy per cent had undertaken further tree planting without any financial assistance from the government, while 36% have planted trees under other tree planting programs. In many cases, these non-CRRP plantings were partly a consequence of the demonstration effect of CRRP plantings. However, the total area of these non-CRRP plantings for all CRRP participants in the two shires was only 138 ha or 32% of the area planted under the CRRP. Nearly all of these non-CRRP plantings are in block areas smaller that the CRRP's stated minimum size, the majority being of less than 2 ha.

Reasons for Participation in the CRRP

Landholders participated in the CRRP for a variety of reasons. About one quarter ranked timber production as the primary motivation behind the decision to participate in the program, and another 20% ranked this as a moderately important factor. This was followed closely by the goal of creek-bank

stabilization with about 20% ranking this as the primary reason for planting. Land 'rehabilitation and conservation' was reported as the primary reason by about 10% of respondents. Other not so important reasons for participating included planting for aesthetics, provision of shade and shelter, and creation of windbreaks. Landholder reasons for participating in the CRRP differed from the four stated goals of the program, with timber production and creek-bank stabilisation being the only two announced goals receiving general support.

Reasons for Non-CRRP Plantings

Landholders were asked their main motivation for non-CRRP plantings, whether they be unassisted or through other tree planting programs. Responses are reported in Table 1. Timber production is the most frequently cited motivation. This is followed by environmental conservation, windbreaks, aesthetics, creekbank stabilization, weed control, shade and shelter, and scientific research. The notable difference between reasons for CRRP and non-CRRP plantings is the high ranking of windbreaks in the latter, indicating the importance of small fenceline and strip plantings.

Future Management Intentions of CRRP Plantings

Further support for the multi-purpose planting objectives of the CRRP can be derived from the future management intentions of landholders (Table 2). More than half of the CRRP landholders intend to manage their plantings to optimize a number of benefits including timber production, soil and water management and conservation. Only about 10% of participants intend to manage their plantings solely for one of the objectives of timber production, soil and water management or conservation. Approximately 15% do not intend to have any active role in managing their plantings. Management intentions can also be expressed in terms of proportion of area planted. By this criteria, the proportion of plantings for timber production as a dominant use is increased from 14% to 24%. The implication is that those planting for timber are planting larger areas than those planting for other reasons.

Table 1. Landholder reasons for undertaking non-CRRP tree plantings on their property

Reasons for planting	Fraction of surveyed CRRP landholders (%)
Research	2.17
Shade/shelter	4.34
Creek stabilization	10.87
Weed control	8.7
Windbreak	19.57
Aesthetics	17.39
Timber	32.61
Conservation	21.74

Table 2. Landholders management intentions for their CRRP plantings, by proportion of area and proportion of respondents

Management intention	Proportion of area (%)	Proportion of landholders (%)
Timber	23.9	13.9
Soil/water management	5	8.3
Conservation	7.9	11.1
All reasons	52	52.8
Ignore	11.2	13.9
Clear the area	0	0

Results of the survey indicate that on average landholders expect to harvest about 70% of their CRRP area. Indeed, 36% of landholders stated they do not intend to harvest any of their CRRP trees, while 47% intend to harvest all of their CRRP trees. A substantial proportion of plantings are unlikely to ever be harvested. In almost all cases, the preferred harvest regime is selective logging and replanting. It can be assumed from the small area of CRRP plantation establishment and the preferred harvesting methods, that the contribution of the CRRP to the re-establishment of a timber industry will be limited.

About 65% of CRRP plantings had a riparian component. The total area of creek bank revegetation by the landholders surveyed was 159 ha or 37% of the total CRRP planted area in the two shires.

Discussions with landholders suggested that attitudes to plantations and perhaps management intentions tend to change over time. Initial plantings are designed primarily for timber production, but as the trees grow the non-timber benefits tend to become more important to landholders.

Observations about Wildlife Population Changes

In terms of wildlife numbers, about 70% of landholders noticed an increase associated with their CRRP plantings, and nearly 30% reported a large increase (Table 3). Although species level identification was likely to be unreliable, there appears to be a general increase in avifauna and some small mammals in the areas of plantings. It should however be noted that the majority of wildlife associated with the CCRP planting are species associated with open-forest habitat rather than rainforest specialists (Catteral, 2000; Catterall *et al.*, in press). Wildlife records collected by CRRP participants contributed to research being conducted by NatureSearch, a Queensland Parks and Wildlife Service program. NatureSearch enlists members of the community to gather information on Queensland's flora and fauna. Wildlife sightings are recorded onto WildNet where they can be utilized by managers, planners, biologists and naturalists, for a range of conservation purposes. This recording system can provide information about the wildlife using CRRP plots (for example) and help demonstrate the value of these plantings as wildlife habitat. It was also envisaged that

NatureSearch would enable the development of guidelines for future farm forestry plantations if attracting wildlife were an important motivation for the landholder. Further university and Greening Australia studies are being conducted on species that use the plantings for habitat, food and shelter, as well as the floristic diversity of plantings. It is notable that thorough maintenance of plantings reduces structural diversity and therefore habitat value resulting in a management trade-off.

Table 3. Changes in wildlife numbers in CRRP plantations

Change in wildlife numbers	Proportion of landholders (%)	Proportion of area (%)
No increase	25	30
Some increase	55	42
A lot more	20	28

Relationships of Planted Areas to Remnant Vegetation

About 60% of CRRP plantings by landholders were reported to form part of a continuous or stepping-stone vegetation corridor network. More than half of the plantings (55%) adjoin an existing forested area (hence taking the form of buffer plantings), and about 20% more are within one kilometer of a forest area.

A total of 63% of respondents reported having existing native remnant or regrowth forest on their property, the aggregate area being 1145 ha. Of this, about 82% was rainforest, 15% was eucalypt forest and 3% was mixed rainforest and eucalypt forest. Nearly half (45%) of existing (non-CRRP) forest areas are smaller than 5 ha, though close to a quarter are larger than 35 ha. With regard to the management intentions for existing forest areas, 27% intended to manage for conservation purposes, 9% planned selective logging and 64% had no management intentions.

DISCUSSION

The CRRP provides an example of a rainforest reforestation program with both timber production and environmental objectives. Individual plantations are small (many 1-2 ha) and have relied on a narrow species pool, based on *Eucalyptus, Flindersia* and *Araucaria* (Lamb *et al.*, 1997; Catterall, 2000). Tree spacing is typically around 3-4 m (about 1000 stems/ha), denser than typical commercial plantings, but sparser than biodiversity orientated plantings, where trees are typically spaced 1.5-2 m apart. This relatively wide spacing for rainforest species in the CRRP plantations reduces the likelihood of tree-to-tree competition, but increases the time taken for canopy closure, resulting in a greater maintenance effort to reduce competition from weeds. Whilst many landholders fully embraced the concept and accepted their role in plantation maintenance, others did not, and many plots experienced considerable weed

invasion and high tree mortality. CRRP records indicate that, by 1998 when planting under the program was coming to an end, at least 15% of plantations had ceased to have economic yield potential. The main cause was poor maintenance – particularly lack of weed control and pruning and cattle damage (even though plantations were fenced).

Notably, the CRRP has been successful in establishing some environmental plantings. Many of the plantings form part of a corridor network or a buffer to existing forest remnants. These plantings are likely to aid biodiversity conservation, particularly at the landscape scale, across the Atherton Tableland. Their value in biodiversity conservation is of course low compared with ecological plantings carried out in the same region (Tucker *et al.*, in press) and is the subject of current research initiated through the Rainforest CRC (Catteral *et al.*, in press; Wardell-Johnson *et al.*, in press). However, the initial establishment cost is only of the order of 20% of that of restoration plantings.

While up to 150 species were included in the CRRP species list, the numbers of species in each plot planted is small (typically five or less). This, together with wide spacing of plantings and the thinning and pruning activities may limit their role in biodiversity conservation (Tucker *et al.*, in press; Catterall *et al.*, in press). In addition, the small discontinuous areas available for reforestation on many private properties lend themselves more to the purposes of shelterbelt, corridor and buffer plantings, and streambank and other erosion control measures, rather than commercial forestry.

ACKNOWLEDGEMENTS

We would like to thank the landholders in the Atherton and Eacham Shires for providing information in the survey, and the CRRP and Rainforest CRC for financial support, as well as Steve Harrison for constructive comments on drafts of this paper.

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