Submission to The House of Representatives Standing Committee on Science and Innovation, Inquiry into the Coordination of Science to Combat the Nation's Salinity Problem

From the Forest Products Commission of Western Australia

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Summary

The Forest Products Commission brings what is probably a unique positioning to this enquiry. Not only has it initiated major reforestation[1] schemes on farmland and developed State policies related to reforestation for salinity control, the State has also been directly responsible for the establishment of 75,000 ha of plantations on farmland since the late 1980's, and uses, commissions and undertakes science relevant to this task. This reforestation has included significant activity (15,000 ha of *Pinus pinaster* establishment) in lower rainfall areas, not normally favoured for forestry, by developing a mix of products (wood, carbon sequestration and salinity amelioration).

In our submission we elaborate on several key gaps in knowledge related to using reforestation as a treatment for salinity, these falling into three areas:

- Where and how to reforest for maximum effect,
- Clear definition of products and markets from forestry in dryland areas,
- Optimized planting systems (silviculture) for those regions where plantation and farm-forestry have not been previously practiced.

At the operational level, science has been readily adopted where it has been shown to work and produces improved outcomes. Where there is uncertainty about science, there is less adoption. There is still an inability to answer some of the fundamental questions about the treatment strategies for cleared agricultural catchments. There are significant research gaps, and conflicting messages, related to the appropriateness of hydrological models, tree placement strategies for control of salinity and the place of new technologies. Similarly, much existing science is not applied due to complexity or inappropriate scales of application.

We consider that these gaps are not being adequately addressed within existing science funding frameworks. Significant scientific investment is required to unequivocally resolve issues such as (1) the circumstances where partial reforestation of agricultural catchments will most effectively stabilize or reverse salinity, (2) resolve issues related to optimal tree placement in agricultural landscapes, (3) develop new industries and products based on trees in dryland areas and (4) develop methodologies that will allow the trading of the environmental benefits provided by reforestation.

Science has resolved previous controversies related to the development of salinity and significant scientific investment is now required to unequivocally resolve the issues of whether

[1] Here we use this term for both plantation and farm-forestry

partial reforestation of agricultural catchments in conjunction with other measures such as engineering can reverse or stabilize salinity, and develop new farming systems incorporating trees. This could take the form of science investment in large (500 to 5,000 ha) catchment scale experiments, with various reforestation treatments.

To achieve this requires a significant change in the quantum of science funding, the need for representation of science-users on research prioritization committees and a funding base for research projects that recognizes the decadal (at least 20-30 years) response times in hydrology and forestry experimentation. We suggest the funding increase can be achieved by allocating a proportion (5%) of the funding already allocated to the National Action Plan for Salinity and Water Quality. We also consider that current arrangements for extension and salinity monitoring are adequate, the limiting factor being lack of knowledge rather than inefficiencies in training and extension.

Introduction

The Forest Products Commission (FPC) [1] is a trading enterprise of the Western Australian Government, responsible for the development and marketing of timber products from native forests and public plantations. The FPC was devolved from the Department of Conservation and Land Management (CALM) in 2000. Both in its present form, and as the Plantations Business Unit in CALM, it has been responsible for instigating the widespread development of plantations on farmland in higher rainfall areas of southwestern Australia. This development followed State agreements with several international investors and has also resulted in the development of a new industry with significant private sector investment, independent of the FPC. More than 200 000 ha of plantations have been established since 1990. Following this lead, significant establishment of trees has occurred on farmland in other States [2].

A major thread of this earlier program was the need to revegetate farmland to achieve improved natural resource management outcomes, and in particular the amelioration of salinity [3, 4]. In south-western Australia it is estimated that up to 7 Mha of land will be affected by salinity by 2050 [5], all inland water supplies will be salinized, up to 450 species are at risk of extinction [6] and apart from significant loss of farmland productivity [7] there is significant threat to infrastructure [8-10].

Although it has been recognized that the scale of the problem is huge [8], any investment in reforestation is likely to be limited from public funds. Thus, if commercial drivers can be identified, investors will establish trees for profit, with collateral environmental benefits. Whereas the establishment of trees in higher rainfall areas is profitable, both due to relatively high growth rates and proximity to infrastructure, in lower rainfall areas (less than 600 mm/year) trees grown for wood production alone are often not profitable and other sources of income from the trees are required. The concept of 'self funding Landcare" has thus been further explored with investigations of other products available from trees such as carbon sequestration [11, 12], bioenergy, mallee oils [13] and improved water quality [14].

The FPC has recently developed an investment package "Infinitree" [15] that is designed to tackle salinity via reforestation with a number of commercial species in the Western Australian agricultural zone. Elements of this package include returns to investors for timber products and carbon credits while also protecting land and water supplies from salinity and protecting endangered remnant biodiversity. This is an extension of the earlier Maritime pine program, that has resulted in the establishment of 15,000 ha of *Pinus pinaster* plantations in lower rainfall regions of Western Australia with BP Australia included amongst the investors. This is Australia's largest dryland reforestation scheme to date.

The FPC thus brings what is probably a unique positioning to this enquiry. Not only has it initiated major reforestation schemes on farmland and developed State policies related to this area, it has also been directly responsible for the establishment of 75,000 ha of plantations on farmland since the late 1980's for a range of clients, and uses, commissions and undertakes science relevant to this task. .

As a statement of principle, the FPC has always supported a strong scientific underpinning for its activities, making an investment of $1 million/year, involving scientists from several institutions including two Cooperative Research Centres[2]. Developing systems for the establishment of trees on farmland was not without significant difficulties, however these were overcome following targeted research and development investment [16]. We suggest a similar situation pertains to the issue of using reforestation to manage salinity on farmland. There are several technical barriers to widespread adoption, however with appropriate science investment it is likely they will be resolved.

It is from this perspective that the FPC makes a submission to the House of Representative's Standing Committee on Science and Innovation Inquiry into the Coordination of Science to Combat the Nation's Salinity Problem.

Science issues

We confine our remarks to the science required to underpin the use of commercial reforestation to restore hydrological balances at a catchment scale and rehabilitate already salinized land.

We frame our comments on the Standing Committee's Terms of Reference in relation to several key technical issues related to using reforestation as a treatment for salinity. These issues broadly fall into four areas:

1. Where to plant trees for maximum effect

Although it is reasonably certain that total reforestation of agricultural catchments will restore the water balance this is only feasible for areas where there is need to restore water quality, such as water catchments [14]. Permanent reforestation is certainly not applicable to the broader agricultural landscape as it will displace farming [14].

For these lower rainfall areas, there are a number of questions that still require resolution:

a) In what circumstances partial reforestation of farmland will most effectively help restore catchment water balances,

b) How these plantings should be integrated with agricultural systems (e.g. strips interspersed with agriculture, blocks rotated in time [14, 17]), and

c) Where in the landscape they should be placed for optimal effect (dispersed across the landscape, planted in particularly leaky areas, planted adjacent to saline areas).

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[2] Greenhouse Accounting and Plant Based Management of Dryland Salinity

2. New products and markets

Much of the area affected by salinity has relatively low rainfall and is distant from ports and processing facilities. Traditional forestry products (e.g. pulp wood or timber production) may be unprofitable in their own right, and if the self-funded approaches for tackling salinity are to succeed it is essential that additional profitable products be identified.

This will partly be through the selection of new tree species for these areas, and developing new markets for wood products such as bioenergy and industrial oils. To attract investment will require prediction of the likely amounts of product that will be produced.

Considerable effort is also required to develop environmental markets, such that payments are made for the collateral NRM benefits of reforestation such as improvements in land and water quality, carbon sequestration and biodiversity conservation. To value these latter products will require standardized methods of measuring changes in condition, predicting the amount of change that will occur and monitoring the changes and reporting these to investors. These processes are relatively advanced for carbon, as its measurement is an offshoot of standard plantation inventory, but less so for other environmental credits, and in particular water and biodiversity.

3. Optimizing planting systems (silviculture)

Although profitable silvicultural systems have been developed in higher rainfall areas, the different soils, climate and production systems in the lower rainfall areas require development of appropriate silvicultural systems. This is quite applied research where the various inputs are optimized for various environmental conditions and profitability is directly enhanced. Periodic droughts are a feature of this environment and require conservative management of plantation leaf area and hence growth rates [16]. Management of plantings to optimize wood quality for a range of traditional and novel wood products also presents a challenge.

Response to Terms of Reference

1. Use of the salinity science base and research data (including the development of new scientific, technical and engineering knowledge) in the management, coordination and implementation of salinity programs

At the operational level much of recently developed knowledge about how to establish trees on farmland (e.g. site selection, weed control, soil fertility management, cultivation) has been adopted, to the extent that it is possible to establish trees and achieve successful establishment on all suitable sites [16, 18].

Where there is uncertainty about the science, however, adoption may be lower. As indicated above, there are significant gaps in the knowledge related to reforestation to control landscape scale recharge and recover land affected by salinity, particularly as applied to the Western Australian environment. These gaps often result in conflicting messages that make decision-making difficult for investors, policy makers and field operatives. The uncertainty also makes marketing difficult as landowners and communities need to understand what specific benefits they will get

These conflicting messages include:

- Uncertainty about where traditional recharge-discharge models for landscape scale water movement work and thus whether whole landscape recharge control is an appropriate response to salinity, or whether reforestation and engineering works can be targeted to specific areas.
- Whether salinity should be tackled by recharge (e.g. across the landscape) or discharge (e.g. adjacent to or on salt scalds) planting [19], or a combination of the two. Some studies suggest that these latter plantings will not survive [20], whereas others report modest growth but good survival up to 25 years after establishment [21].
- In what circumstances partial, dispersed plantings of trees, or belts of trees, in landscapes will most effectively stabilize landscape hydrology [14, 19].
- The overall benefits and dis-benefits of different methods of planting trees in landscapes (e.g. strips interspersed with agriculture) in terms of agricultural production,
- The role of soil properties in contributing to recharge and the amounts of recharge associated with existing farming systems. For example, some studies suggest that soil properties are important in controlling the rate of recharge [22, 23], whereas other studies suggest that soils are not important. Similarly, there are problems in the estimation of recharge rates [24].
- Whether new technologies such as electromagnetic induction have application to salinity management. Although this has been advocated as part of the National Action Plan for Salinity, and by commercial operators [25], this view has not been consistently supported by research in Western Australia [26].

Another set of issues relates to the utility of the science, and particularly that relating to placement strategies. Many models are scientific tools, rather than tools for land managers [24] and are unsuitable for application at paddock scales. Although much existing science has been summarized in publications such as "Trees, Water and Salt" by the Joint Venture Agroforestry Program [27], these guidelines are quite generalized and it is often difficult to make decisions about specific tracts of land. Similarly, many regional data sets are at an inappropriate scale (e.g. at district rather than farm level) on which to base activities in specific paddocks and do not provide clues as to appropriate management interventions. This suggests that a priority is to develop robust decision support aids and tools and back these up with training programs.

Whereas, it is relatively inexpensive to evaluate the effectiveness of weed control or fertilizer practice through experimentation, the same does not apply to catchment scale responses to reforestation. Sometimes, however, research investment is needed at a considerable scale to resolve particular problems. Similarly, both hydrological and reforestation research operate at time scales (e.g. multiple decades) that are outside normal research funding cycles (1-5 years). For example, typical forestry rotations are between 10 and 30 years, and landscape responses to reforestation may be at a similar time-scale, if not longer.

There is an excellent Western Australian example on the use of science to resolve an issue related to salinity. In the 1960's and 1970's there was particular controversy about the causes of salinity in this state. This was resolved through the establishment of catchment scale land-clearing experiments near Collie, in a project involving several institutions. These experiments have unequivocally demonstrated a causal link between land-clearing and water table rise [14, 24, 28].

Models and concepts developed for the Murray Darling Basin are often inappropriate for Western Australia for the simple reason of distinct geology and climate between the two regions and it is important that research is performed in this environment, particularly with the acute salinization problems in this region.

Significant scientific investment is now required to:

- Unequivocally resolve the issue of the circumstances in which partial reforestation of agricultural catchments can most effectively reverse the salinity problem. The FPC suggests that this should take the form of catchment scale experimentation analogous to the Collie Catchments, where agricultural catchments of reasonable scale (500 to 2,000 ha), in lower rainfall areas, and with existing salinization, are partially revegetated and the results monitored for 15-20 years. As these catchments will also be used for extension to landholders and policy makers they will need to be repeated in several representative locations.
- Resolve issues related to optimizing placement strategies such as the use of belts and rotating blocks of trees in time, and the utility of new technologies. Work has commenced in these areas [29-31], more is required.
- Develop new industries (e.g. bioenergy) that will require large-scale use of products from reforestation. This development will involve research that ranges from selection of the most productive species, low-cost establishment and harvesting systems, yield prediction and economic and social analyses.
- Develop methodologies that will allow the valuation of environmental benefits such as improvements of land and water quality and biodiversity, so that these can be sold to investors. This is analogous to the emergent carbon market and will involve steps such as the development of a unit of trade, prediction of likely delivery, measurement and reporting.

2. Linkages between those conducting research and those implementing salinity solutions, including the coordination and dissemination of research and data across jurisdictions and agencies, and to all relevant decision makers (including catchment management bodies and land holders), and

Networks between those undertaking salinity research and reforestation practitioners are generally well developed via conferences, community Landcare coordinators and catchment groups, specialized newsletters and web-sites and field days [32]. Similarly, practitioners can undertake a variety of courses to improve their knowledge base.

Much of the information that flows through these networks is quite generalized. As described above, there are significant gaps in the underpinning science, and no amount of extension will redress these, a view promulgated elsewhere [33].

3. Adequacy of technical and scientific support in applying salinity management options

As outlined in #1 above there are significant knowledge gaps that require resolution and consequently there are not well-defined, cost-effective, salinity management options for many situations.

We recognize that there is already considerable Commonwealth and State investment in salinity research and development, and that science funding has to compete with other budget priorities. This said, the amelioration of dryland salinity will require considerable focus onto the most promising outcomes.

Despite significant Commonwealth salinity funding to various research organizations, at the operational level the information used to plant trees has been mostly developed through in-house research and innovation. Simply put, there is still an inability to answer some of the fundamental questions about the treatment strategies for cleared agricultural catchments.

The development of sustainable land management systems requires significant investment over an extended period.

Issues relate to:

- o The quantum of funding and delivery mechanisms. To address the knowledge gaps described in this submission requires a significant change in the quantum of science funding. We suggest the funding increase can be achieved by allocating a proportion (5%) of the funding already allocated to the National Action Plan for Salinity and Water Quality. The Joint Venture Agroforestry Program has performed well and should receive ongoing support, but requires modification in terms of increasing funding available for projects related to reforestation for salinity control, and also ensuring that there is adequate representation of projects that can meet Western Australian concerns.

- o The applicability of science and the need to mix basic research with the development of practical tools that can be used by land managers. This can be partly rectified by ensuring end-user representation in the process of allocating research funding.

- o Timescales of investment and the need to sustain funding for catchment scale restoration projects for periods of 20-30 years.

- o Development of tools that allow the prediction of likely changes in land and stream salinity prior to revegetation and standardized methods of monitoring and reporting changes.

We consider that the nature of the salinity problem has now been well defined and that current arrangements for training and extension are adequate. The limiting factor appears to be a lack of knowledge in the areas we have outlined rather than inefficiencies in training or extension .

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