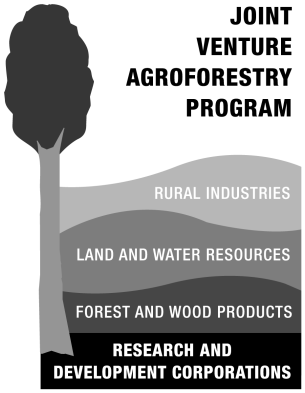

Making Farm Forestry Pay – Markets for Ecosystem Services

A Scoping Study to Set Future Research Directions

A report for the Rural Industries Research and Development Corporation

by Carl Binning, Brendon Baker, Seona Meharg, Steve Cork and Allen Kearns

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FOREWORD

In recent years researchers and policy makers have consistently raised the importance of farm forestry and agroforestry as drivers of landscape rehabilitation to address environmental degradation.

The uptake of agroforestry has, however, been patchy. Some regions, such as the south west of Western Australia, are experiencing rapid growth. Others have little or no activity. The reason for this is largely economic: in the absence of good soils, high rainfall and close access to markets, commercial opportunities for agroforestry have been limited.

This report addresses the challenge of how to make farm forestry pay by identifying key issues connected with providing incentives and commercialising the environmental and social values associated with agroforestry. It introduces the role of markets for ecosystem services in delivering ecological products to investors. It does so with reference to the role of both the government and non-government sectors.

This project was funded by three R&D Corporations — RIRDC, LWRRDC and FWPRDC in relation to their Joint Venture Agroforestry Program. These Corporations are funded principally by the Federal Government.

This report, a new addition to RIRDC's diverse range of over 450 research publications, forms part of our Agroforestry and Farm Forestry R&D program, which aims to integrate sustainable and productive agroforestry within Australian farming systems.

Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/reports/Index.htm
- purchases at www.rirdc.gov.au/pub/cat/contents.html

Peter Core

Managing Director

Rural Industries Research and Development Corporation

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EXECUTIVE SUMMARY

Could a typical sheep/wheat farming system be adapted and diversified over time to include an agroforestry business that sells environmental services to a number of government and non-government investors? (Table 1).

Key issues and research questions for testing the potential of markets for environmental/ecosystem services are identified in this scoping study.

Agroforestry has multiple benefits and, hence the potential to remedy environmental degradation while increasing farm income and farm productivity. Well designed agroforestry operations provide both wood products (ecosystem goods) and ecosystem services including the sequestration of carbon, maintenance of hydrological balances that prevent dryland salinity, and the purification of water. They also potentially complement the conservation of biodiversity – the variety of all life and the physical environment in which life is found.

Table 1: A Farm of the Future?

Commodity	Share of farm business	Potential Client
Wheat	35%	World Market
Wool	15%	World Market
Timber	25%	Specialty and World Market
Carbon Credits	10%	Steel Company
Salinity Credit	5%	Catchment Management Authority
Water Filtration Credit	7.5%	Urban Water Authority
Biodiversity Credits	2.5%	Philanthropic Trust

The problem is that land managers who invest in agroforesty are often not financially rewarded for the ecosystem services they provide. This report asks the questions:

- How far will existing approaches and incentives for promoting agroforestry take us?
- What potential is there to directly reward land managers for the environmental benefits provided by agroforestry?.

Existing Incentives for Agroforestry

Existing approaches to providing incentives for agroforestry are reviewed highlighting the divergence in approach between high and low rainfall regions. In high rainfall regions, with close access to markets, good commercial opportunities for growing trees for profit have emerged with a variety of mechanisms used to access capital finance including joint venture and annuity arrangements. In low rainfall areas incentives are more limited and tend to be tied to addressing land degradation with little or no allowance made for commercial returns.

The following conclusions are drawn in relation to incentives for agroforestry outside the commercial plantation regions of Australia.

- Some typical incentives that encourage trees on farms may provide an economic trigger for previously marginal agroforestry operations to become worthwhile. A range of methods to promote agroforestry have been used, including grants, subsidies on inputs, cost sharing

arrangements and provision of information. For commercially oriented options, the most commonly used method by state governments and forestry companies is by joint venture schemes.

- There remains a range of economic, institutional and social impediments to the adoption of agroforestry. These are generally well understood and documented within the research community.
- Investment into agroforestry in the low rainfall zone is inhibited by environmental and economic factors, including a lack of infrastructure and poor access to markets and capital finance.
- A mix of policy tools that harness the synergies between educational, regulatory and economic incentives are likely to be more effective both in terms of cost and uptake of agroforestry than the use of single instruments.

To some extent existing approaches are effective in achieving their goals – that is, they encourage tree plantings, deliver environmental benefits, and increase the uptake of more sustainable land uses, including agroforestry. However, the rate of uptake is slow, particularly in low-medium rainfall areas where the environmental needs are greatest because of the ongoing degradation of natural resources.

Markets for Environmental Services

Large and innovative market based incentives are needed to be able to move rapidly towards ecological goals.

One approach is to identify alternative commercial products from agroforestry including eucalyptus oil, activated carbon and bio-energy. Another is to remove impediments to adoption including ignorance of on-farm benefits and poor access to capital markets. The Joint Venture Agroforestry Program is investing in research to address these impediments and to develop these products.

Another approach, the focus of this report, is to design mechanisms that are able to capture the financial value of the environmental services provided by agroforestry. The challenge is to create structures that allow investors in agroforestry to capture the full suite of values that arise from agroforestry including commercial and environmental values. Figure 1 provides a conceptual framework for linking potential buyers of ecosystem services with landholders (sellers) who undertake on-ground projects that deliver these services.

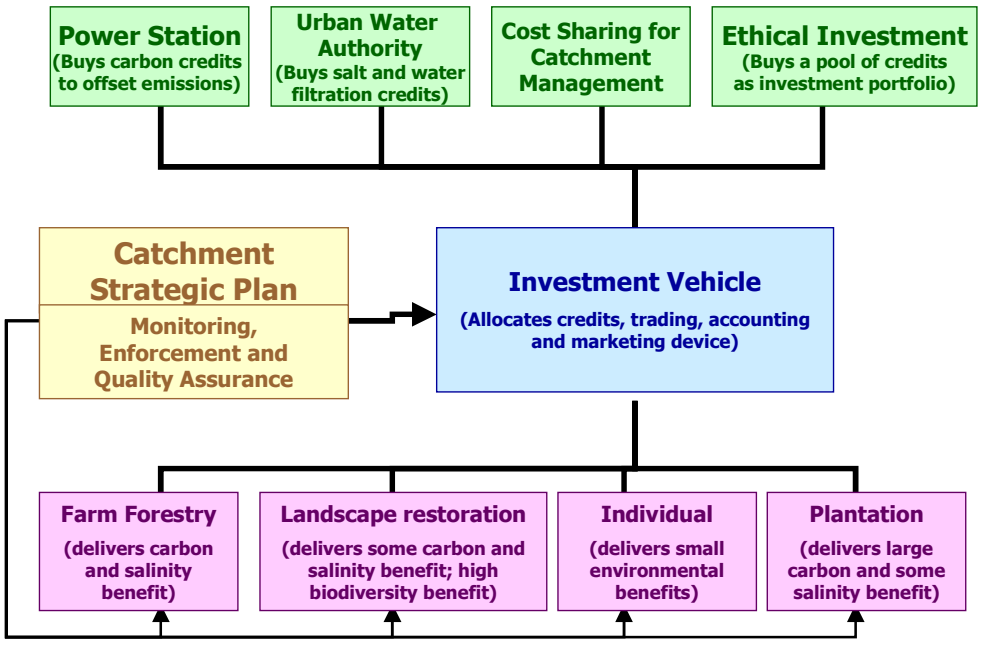


Figure 1: A buyer, investment seller framework for ecosystem services

In the figure buyers create a demand for ecosystem services or commodities through the provision of financial capital. Landholders undertake projects that deliver ecosystem services and commodities to buyers. In the context of this study, landholders undertaking agroforestry operations that have environmental benefits are the sellers of environmental services. This provides an additional economic return for an enterprise.

Finally, a link between buyers and sellers is required. This is the investment vehicle, which is able to draw on many funding sources (buyers) and distribute financial capital to projects. In return for funding, projects provide one or more ecosystem services. The investment vehicle would allow for contracts with many landholders to be entered and, having acquired rights to ecosystem services on various parcels of land, would then on-sell that pool of credits to larger firms. This allows dealers or brokers to pool small amounts of an ecosystem service associated with each project into volumes of interest to buyers.

The buyer-investment-seller framework outlined above provides a basis for understanding and reviewing many existing or proposed models for trading in environmental services. A range of Australian and Interantional case studies are reviewed in Chapter 5. Three key questions arise from this model.

- How are buyers secured?
- How are landholders engaged in projects to supply ecosystem services?
- How are buyers and sellers linked through an investment vehicle?

Securing buyers

Three mechanisms for securing investment in environmental services are identified and discussed.

- **Direct Government Investment:** as is currently occurring through programs under the *Natural Heritage Trust.* Key issues here relate to improving the targeting and efficiency of government expenditure.
- **Voluntary Private Investment**: A number of motivations for voluntary investment are identified ranging through philanthropic, enhancing corporate identity, ethical investment and maximising return from natural assets.
- **Regulated Private Investment**: Caps or limits on resource use have the potential to create scarcity and encourage trade in environmental resources, as has been the case with tradeable water entitlements. Government regulation and enforcement is needed to back any cap and trade system.

It is unlikely that direct government investment will continue to be the major source of funding for environmental services in the short term. The potential role of voluntary investment is likely to be modest, although the future growth of ethical investment is difficult to gauge. Voluntary investment could, however, have a demonstration effect that will give governments the capacity to more effectively regulate resource use.

It is concluded that large scale markets for environmental services will emerge in the absence of government backed restrictions on resource use and access. The current policy issue is to determine how existing government and voluntary private investments can be used to test and experiment with design of new market structures.

Securing Sellers

Successfully engaging landholders to change land-use and invest in agroforestry is a challenging task. The need to use an appropriate policy mix is discussed as is the role of a range of incentive based

mechanisms ranging through catalytic and direct grants, cost-sharing arrangements and auction based systems.

All of these instruments have their place in the policy toolkit for encouraging landholders. Selecting instruments will depend on the objectives set. For demonstration purposes catalytic incentives tied to strong extension programs will be most effective. Greatest value for money will, in theory, be achieved through auction based systems although at some cost equity.

Investment Vehicle

An investment vehicle is any mechanism through which buyers and sellers of environmental services are brought together. The existing administrative arrangements surrounding the delivery of government programs is an example of an investment vehicle – albeit restricted in its focus.

An investment vehicle could be as simple as donating to a charity such as the *Australian Bush Heritage Fund* that in turn directly invests in landscape restoration, in this case through the purchase and management of high conservation value properties. Alternatively it may be as complex as a trading desk for carbon futures with complex verification and quality assurance processes.

Each investment vehicle distributes a range of costs, risks and security between the different players. A major challenge is to design simple and administratively lean investment vehicles that can grow in their complexity as markets, themselves, grow.

There are a number of challenges associated with the buyer-investment-seller framework. These include the ability to "count" and "credit" ecosystem resources, such as carbon, salt, water, and biodiversity and to develop a rigorous and transferable accrediting framework. This is not an easy task and there are a plethora of methods suggested for this type of ecological accounting.

Implementation also represents a significant scientific challenge, as the measure chosen must have credibility in the market place. For example, measuring and monitoring carbon credits or biodiversity credits demands rigorous, efficient and practicable methods that are still being developed.

Another issue that needs to be considered is the setting of regional targets and caps for the use of ecosystem resources. This is required as a regulatory measure to create scarcity and hence an economic demand.

The mechanics of any trading system are yet to be fully devised, leading to questions on the rules for trading. The issue of property rights is also an important issue. For example, what are the consequences of clearing land owned by several parties? Additionally, monitoring, enforcement and quality assurance are needed for successful implementation.

This report highlights the potential role of agroforestry as a driver in the creation of markets for environmental services. Key issues and challenges that require further research and policy development over the coming years are set out in Box 1.

Rhetoric or Reality – Can Markets for Environmental Services Be Created?

Market creation is hard work. Markets for environmental services will take time to develop - risk taking and experimentation will be required.

Governments face a number of legal and political constraints in establishing new markets. As new markets emerge there will both be successes and failures. The key research issues identified in the report also highlight that a number of important technical issues need to be resolved, such as developing a robust and credible accounting framework for environmental services. This will, inturn require the systems developed to be adaptable. However, resource users generally require certainty from governments.

Because of these constraints it is useful to consider if markets for ecosystem services and commodities could be created at arms length from government. One potential model for the growth and transition into markets for ecosystem services and commodities at a regional scale is put forward highlighting the need to work with "early adopters" from the non-government sector the who voluntarily invest

either for philanthropic reasons or because they have a strategic interest in helping to define how markets for environmental services will emerge.

Key Issues and Research Questions

An analysis of existing policy tools reveals that agroforestry often falls between the gaps of government programs directed at commercial forestry and those directed towards environmental outcomes. This leads to the requirement for better integration of different government programs and a more mature approach to the combined commercial and environmental benefits of trees on farms.

Key Research Question 1: Defining, accounting and crediting ecosystem commodities

Accounting standards for the environmental services provided by agroforestry including carbon sequestration, biodiversity conservation, ground water balance (salinity) and water quality are yet to be developed and operationalised. Scientifically credible environmental accounting systems are a key step to achieving recognition of the environmental benefits of agro-forestry.

Key Research Question 2: Disciplined regional planning

Markets for environmental services will need to be developed in the context of appropriate regional natural resource management targets that can be used target environmental expenditure. Ensuring consistency between market based tools and regional planning is a considerable challenge.

Key Research Question 3: Leveraging private investment

Governments cannot provide adequate funding for environmental services alone. Government investments in incentives for improved environmental management will increasingly need to be targeted at leveraging private sector investment. A major challenge is to develop new innovative mechanisms that secure greater non-government participation.

Key Research Question 4: Designing the Investment Vehicle

Different investment vehicles for environmental services will have different levels of risk and security associated with them. The design of new and innovative investment vehicles will require increased innovation and interaction between researchers and the financial sector.

Key Research Question 5: Coordination with environmental management systems and environmental certification

The role of environmental accreditation will need to be effectively integrated with markets for ecosystem services. Environmental certification and best practice management systems are potentially a critical first step in developing the quality assurance processes required to successfully create markets for ecosystem services.

Key Research Question 6: Caps and regulations

Any market for ecosystem services will ultimately require caps on resource use to be regulated to create scarcity in environmental goods. To create a market property rights need to be assigned and trading rules developed. Hence markets are in fact highly regulated. The design and implementation of flexible and adaptable trading regimes is critical.

Key Research Question 7: Transition – Moving from rhetoric to reality

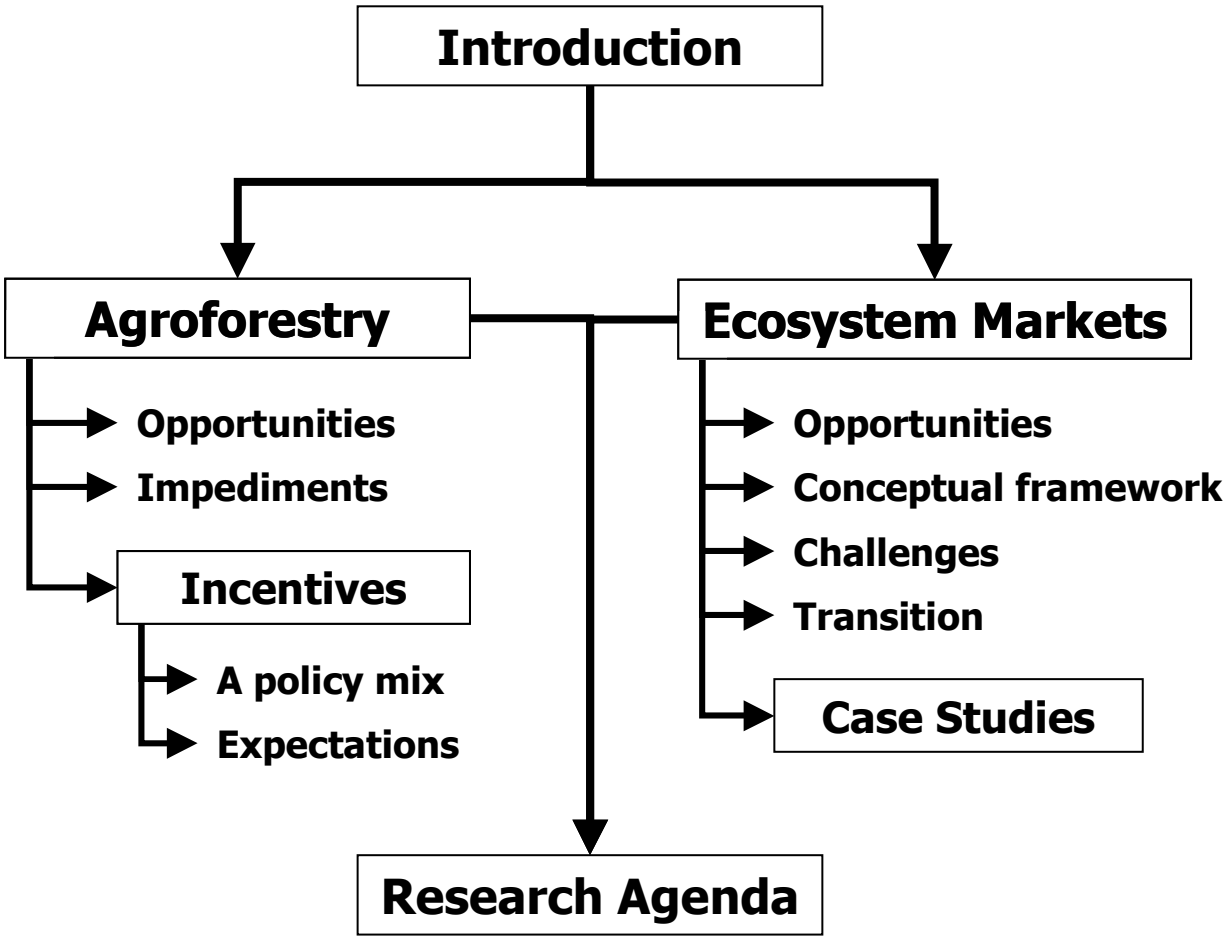
How do we move from rhetoric to reality? How should risk be shared? How do we attract new investment? These are all key questions. The process of establishing ecosystem accounting standards and undertaking more disciplined regional planning is a necessary starting point. The issue is whether this process can be married with one of market creation. What is required is a process of participatory research in a number of regions to facilitate a process of policy learning.

Markets for environmental services are not a panacea. They will only supplement established commercial markets for wood products. Further they will not provide a magical solution to Australia's pressing environmental problems. However, markets for environmental services have the potential to add value and complement the broader suite of policy tools available. The role of markets for environmental services remains under-explored.

The concept of developing markets for environmental services is not focussed on privatising the environment or giving unfettered reign to markets. The role of government will remain critical. The major finding of this study is that irrespective of who invests, government or private interests, the key steps involved in market creation will facilitate more effective on-ground delivery and uptake of agroforestry by landholders. Pragmatic research of market structures for environmental services will allow two critical issues to be addressed:

- Firstly, the contribution of different agroforestry projects to meeting natural resource management targets can be quantified and ranked allowing more effective targeting and integration of government programs; and
- Secondly, the potential to leverage private sector investment can be tested through either voluntary action or by regulating resource use by placing caps on the use of key environmental assets.

REPORT ROAD MAP



This report addresses the challenge of how to make agroforestry (or farm forestry) pay by identifying key issues connected with providing incentives and commercialising the environmental and social values associated with agroforestry. It introduces the role of markets for environmental services in delivering ecological products to investors.

Chapter 1 provides an **introduction** to agroforestry in Australia. In Chapter 2, the considerable opportunities for **agroforestry** in the Australian landscape are discussed, and then balanced by looking at the range of impediments for the uptake of agroforestry. Typical Australian **incentives** are discussed in Chapter 3 with a view to assessing how far the existing policy mix can take us in implementing agroforestry activities in Australia, particularly the low to medium rainfall zones.

Following the conclusions reached on current incentives and policy alternatives, the role of **ecosystem markets** are examined in Chapter 4. The opportunities for ecosystem markets in delivering improved outcomes for tree plantings, including agroforestry are highlighted. A conceptual framework is introduced in some detail, leading to discussions on challenges for, and the transition to, markets for environmental services. Chapter 5 provides some **case studies** of existing market-based opportunities to invest in ecosystem services.

Finally in Chapter 6, the report highlights a **research agenda** that will require further development over the coming years.

1 INTRODUCTION

1.1 Background to agroforestry in Australia

Agroforestry is a relatively new term for an old agricultural practice. Agroforestry's re-emergence began in the 1970's during a period of re-examination of World Bank and FAO policies and strategies. The problem was that agricultural systems in developing countries were failing to meet the production needs of the growing population, or in the attempt to do so were degrading land and water resources. Natural forests in these regions were also under unsustainable pressures from loggers and encroachment from agriculture. Agroforestry was seen as a means of:

- enhancing the productivity of agriculture;
- providing an alternative source of timber and fuel needs — protecting forests;
- providing poorer farmers with stable income; and
- enhancing environmental values of the region (University of Adelaide 2000).

So what is agroforestry? There are many definitions of agroforestry, however in this report we will use the internationally accepted definition which was developed by The International Centre for Research into Agroforestry (ICRAF) at Nairobi, Kenya:

> "Agroforestry is a collective name for land use systems in which woody perennials (trees, shrubs, etc.) are grown in association with herbaceous plants (crops, pastures) and/or livestock in a spatial arrangement, a rotation or both, and in which there are ecological and economic interactions between the tree and non-tree components of the systems." (Young 1989)

Agroforestry, also called farm forestry, can be broadly described as "the management of trees and shrubs integrated with agricultural systems for multiple products and benefits" (RIRDC 1999). Agroforestry is not the intense management of stands of trees on broad acre blocks. Plantation forests represent less than one percent of Australia's forests, mostly as broad acre blocks. However, plantings are increasingly being used as part of farm management plans in small wood lots, shelter belts or integrated into existing land uses, to supply wood and other benefits such as environmental protection (Burns et al. 1999).

Australia has really only experienced active farming in the last 200 years and for most of this time the land was viewed as a seemingly endless untapped resource. Added to this, agroforestry practices in Australia are somewhat different from agroforestry practices in the developing countries of the tropics because of the very different ecological and socio-economic circumstances under which they have evolved.

The widespread clearing of trees and other native vegetation has had unforeseen consequences. For example, in parts of the continent, most markedly in the Murray Darling Basin and the West Australian wheat belt, the removal of trees has had a devastating effect on the hydrological balance. Water tables have risen, bringing salt held in the soil profile to the surface. Dryland salinity is currently estimated to affect 2.5 million hectares of farmland; with the potential for this to increase to 15 million hectares. The area damaged by salinity represents about 4.5% of presently cultivated land, and known costs include $130 million annually in lost agricultural production; $100 million annually in damage to infrastructure; and at least $40 million in loss of environmental assets. Rising river salinity is another major issue estimated to cost at least $55 - $60 million is rising water treatment costs in Adelaide alone (RIRDC 1999, PMSEC 1998). As a result much of the early agroforestry in Australia has been aimed at re-vegetating the landscape with trees to combat salinity and other land degradation problems such as soil erosion.

Across Australia 25% of land managers plant trees, mainly for agricultural protection and production (through wind breaks, shade and shelter). Salinity control and soil conservation are other common reasons for tree planting. These priorities change in wet (>650 mm annual rainfall) and dry (<650 mm) zones of Australia. In wetter areas, farmers are more likely to be planting trees for commercial timber

production than for soil conservation. In dry areas trees are planted mainly for shade and shelter of stock.

Broadly speaking, farmers plant trees for four main reasons (RIRDC 1999):

- New product diversification: tree products such as wood, pulp or oils provide opportunities to generate new income;
- Enhancement of existing enterprises: agroforestry can increase the productivity of a traditional pasture-based enterprise through ecosystem services, such as for example, the provision of shelter for animals and crops;
- Natural resource protection: trees can help protect the quality of soil and water resources. For example, trees may help limit wind and water erosion. Depending on the scale and configuration of plantings and their position in the landscape, they can also help in salinity management;
- Conservation and beauty: trees add horizontal and vertical structure to the landscape and provide new niches for other plants and animals. Trees can be planted to buffer remnant vegetation and to provide wildlife corridors.

The Joint Venture Agroforestry Program (JVAP) was established in 1993. It is a collaborative undertaking by three R&D corporations: Rural Industries (RIRDC), Land and Water Resources (LWRRDC), and Forest and Wood Products (FWPRDC). Additional funding has been provided for some activities by the Murray Darling Basin Commission, the Grains R&D Corporation, the NHT, the Department of Agriculture, Fisheries and Forestry, Australia (formerly the Department of Primary Industries and Energy), the Australian Greenhouse Office and the Cotton RDC ,and private investors. The JVAP invested about $1.5 million in agroforestry R&D in 1995/96, $2.0 million in 1996/97 and $2.6 million in 1997/98 (RIRDC 1999).

In 1997 the Commonwealth and State Governments announced the 2020 Vision Framework, recognising the need to promote plantation forestry in Australia. The goal is to treble the effective area of Australia's plantations between 1996 and 2020. The strategy's focus is particularly on addressing the impediments to the wider uptake of plantation forestry. About 60 per cent of Australian lands are managed privately and plantations on cleared agricultural land will be vital to achieving this vision (RIRDC 1999).

In February 1998, the then Minister for Primary Industries and Energy advised that $4 million, sourced from the Natural Heritage Trust (NHT), would be set aside for national farm forestry R&D over three years. Of this $4 million, $1.5 million would focus on the timber production elements of agroforestry and the sustainable management and use of private native forests and woodlands. These funds would be managed by FWPRDC; and $2.5 million would be available to assess new tree crop products and industries with an emphasis on native species and the development of commercial agroforestry as an integral part of sustainable agricultural systems, including biodiversity and the protection of the natural resource base (RIRDC 1999).

The indications are that agroforestry is expanding, particularly in regions such as south western Australia and the 'green triangle' around south eastern South Australia (RIRDC 1999). The reason for this is a combination of environmental and economic issues: in the absence of good soils, high rainfall and close access to markets, commercial opportunities for agroforestry have been limited. In addition, there remains a range of other economic, institutional and social impediments to the adoption of agroforestry. Such impediments include public policy constraints, economic barriers, lack of agroforestry culture, lack of technical knowledge and market impediments.

2 AGROFORESTRY

2.1 Opportunities and impediments

Agroforestry has the potential to rapidly re-vegetate Australian landscapes, providing a valuable natural asset. This asset provides both wood product and ecosystem services, particularly if native trees are used as the agroforestry crop.

Native vegetation and the biodiversity it supports pervades our everyday life to the extent that products directly derived from living organisms feed, clothe and shelter us. Indeed the functions performed by natural ecosystems underpin the production of most of the goods and services that humans value. Examples of the services provided by natural ecosystems include nutrient cycling in soils, pollination, and the assimilation of wastes to provide clean water. More indirectly, ecosystems provide goods and services, such as medicines and products used in other modern technologies (Daily 1997).

In addition to direct forest products, agroforestry operations offer many ecosystem services including the sequestration of carbon, maintenance of hydrological balances that prevent dryland salinity, and the purification of water. Agroforestry also potentially complements the conservation of biodiversity – the variety of all life and the physical environment in which life is found.

For these reasons agroforestry has the potential to be a key driver of landscape rehabilitation that addresses environmental degradation. However, as noted, the uptake of agroforestry at the scale required has been limited to date in Australia. One way to increase uptake may be through provision of incentives or creation of financial markets for environmental services. In this section of the report opportunities and impediments to agroforestry at the farm scale are considered.

Some regions, such as the south west of Western Australia, are experiencing rapid growth in tree plantings because of the increasing role of industrial plantations. Others have little or no activity related to agroforestry.

Burns et al. (1999) identify a number of regions with significant potential for plantation development. Western Australia, Tasmania and the Green Triangle region of South Australia and Victoria each have a relatively well developed processing infrastructure and a large area suitable for plantations. Despite much of the existing land values being relatively high in these regions, Burns et al. (1999) suggest that the economic suitability of these regions for tree plantations is significant. They also identify plantation potential in several other regions, including the Murray Valley region of New South Wales and Victoria, the Central Gippsland region of Victoria and the South East Queensland region. These regions, which are a subset of fifteen regions identified by the National Forest Inventory (National Forest Inventory 1997), are shown in Figure 2.

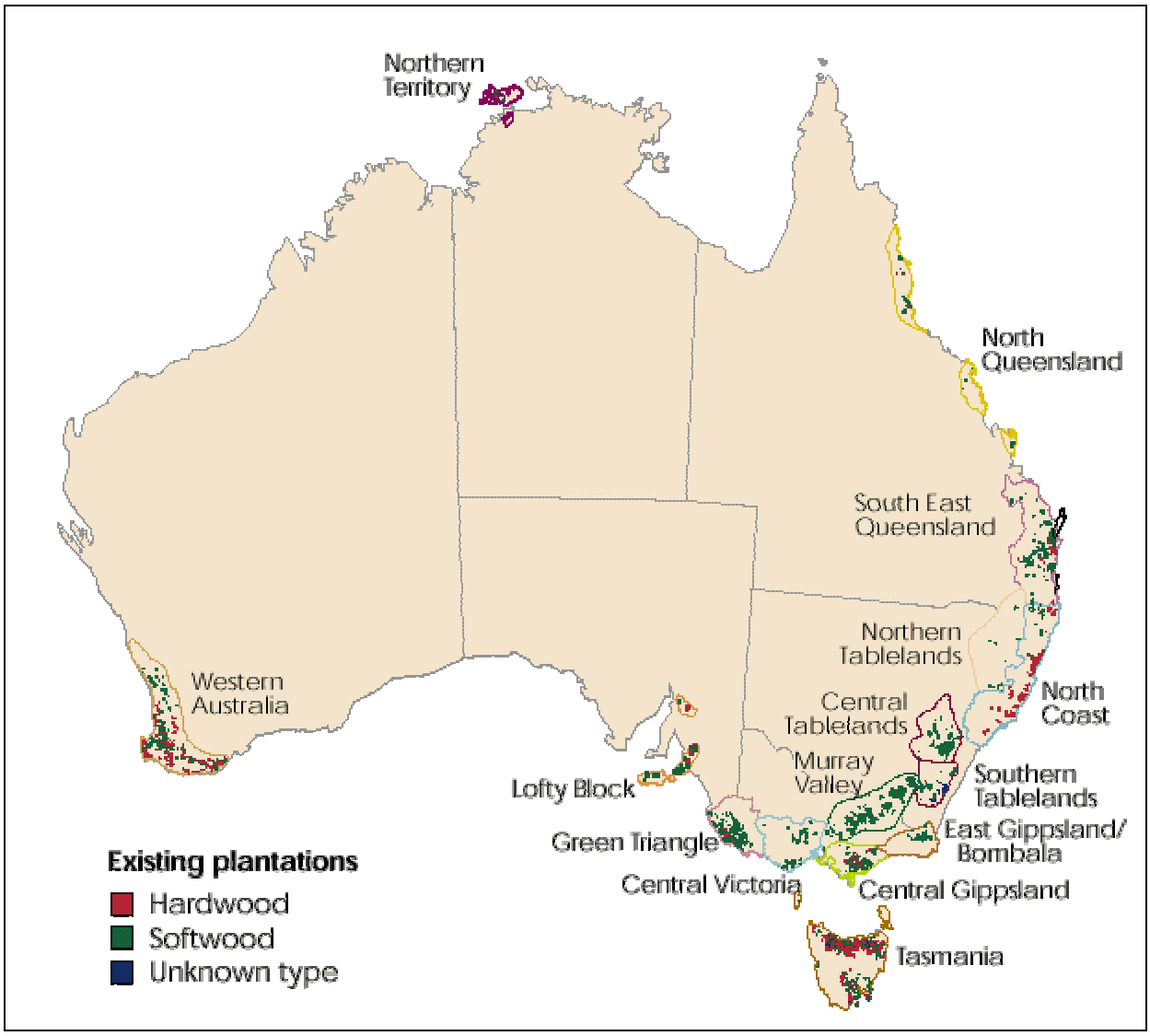


Figure 2: Industrial Plantation Regions of Australia (National Forest Inventory 1997).

The commercially viable industrial plantation regions in Figure 2 are successful due to specific circumstances, such as their occurrence lying within high rainfall zones and reasonable distances to markets. Plantations in These regions are generally intensely managed crops, rather than an integrated agroforestry enterprise. Industrial plantations generally do not address all environmental concerns, in particular biodiversity.

However, uptake of activities within the low to medium rainfall zones has been patchy due to a combination of reasons. Low to medium rainfall agroforestry tends to have a less commercial focus and operate under different incentives, such as government-driven policies or philanthropy.

It is clear that agroforestry offers a range of benefits to farm enterprises (Abel et al. 1997), including returns from wood products, control of dryland salinity and waterlogging, prevention of soil erosion, provision of shade, shelter and fodder for stock, nature conservation, and provision of aesthetic value.

In an ABARE study of trees on farms (Wilson and Tran 1995), it was found that most farmers plant trees for shade and shelter, and also for environmental remediation. Direct commercial considerations were much less significant motivations. In fact, fewer than 10% of farmers in the wheat-sheep zone planted trees to produce wood products for sale.

Trees offer considerable flow on benefits to production systems. These benefits can be measured in dollar values, however they are not direct income earnings. In an income-poor / asset-rich farm enterprise, flow-on benefits are not always useful.

Agroforestry integrated into a farm enterprise may also offer significant protection from risk. For example, windbreaks can result in significant extra income in a year with a catastrophic wind event.

It is important to consider that farm forestry can only be assessed accurately on a case-by-case basis. In many cases, with good planning, farm forestry will offer direct positive economic returns as well as environmental benefits and a positive social impact at personal, family and community levels.

Campbell White & Associates and Black (1999) found that using a whole of farm design approach, eight out of ten case studies had direct positive economic returns from agroforestry.

Table 2: Summary of economic results based on ten case studies (Campbell, White & Associates and Black 1999).

Case study location	Project NPV	NPV environment	Annualised NPV	Prop. / income	Economic impact	Environmental impact
WA	$ 154,068	$ 204,286	$ 13,180	29%	++	+
SA	$ 160,912	$ 185,828	$ 8,525	32%	+	=
Vic	$(28,889)	$ 24,731	$(1,746)	-4%	=	++
Tas	$ 147,912	$ 311,648	$ 8,553	7%	+	+
Vic	$(313,967)	*	$(17,894)	-24%	--	++
NSW	$ 78,668	$ 104,310	$ 4,664	28%	++	+
NSW	$ 1,062	$ 138,353	$ 72	0%	=	+
WA	$ 15,029	$ 190,000	$ 831	0%	+	++
WA	$ 54,143	$ 164,645	$ 3,307	5%	+	+

NPV = Net present value

Prop. / income = Property income / decrease in annual income

+, positive impact; -, negative impact; =, equal impact

* Environmental sensitivity analysis was not undertaken for this site because there were no major environmental productivity problems. However, environmental impact was classified as strongly positive owing to the stabilisation of landslip prone areas with trees.

Zorzetto and Chudleigh (1999) investigated market and economic prospects for agroforestry enterprises in the low rainfall zone of Australia, defined as 400-600 mm average rainfall per year. This study considered wood panel products, fence posts, specialty timber, charcoal and activated carbon, fodder and a range of niche markets. Zorzetto and Chudleigh (1999) analysed in detail sawntimber, firewood, biomass for electricity, and eucalyptus oil. Three prospects emerged reasonably favourably from the assessment – fodder, eucalyptus oil, and biomass.

Importantly, Zorzetto and Chudleigh (1999) found that investment into long rotation agroforestry in the low rainfall zone is inhibited by lack of infrastructure and time to harvest, which may be anything from 30 to 60 years. However, short rotation biomass systems are more suited to these regions in many cases.

In the most valuable case, base results for a biomass investment yielded an NPV for a 30-year investment of $855,182 (noting the start-up costs in this example were $750,000).

In summary, trees on farms are often economically marginal due to poor access to markets and the problem that multiple benefits may be hard to realise and/or difficult to make transparent. The flow-on benefits are not always in the form of direct income earnings. However, agroforestry activities often make good economic sense when using a "whole farm" approach. There remains different motivations for agroforestry for different people – some landholders will plant trees at great financial cost with little prospect of a financial return. Others will not invest without a projected commercial profit.

Some typical incentives that encourage trees on farms may be a useful trigger for an economically marginal scenario to be worthwhile. A range of methods to promote plantations have been used, including grants, subsidies on inputs, cost sharing arrangements and provision of information. The most commonly used method by state governments and forestry companies is by joint venture schemes (Burns et al. 1999). Such schemes are addressed in more detail in Chapter 3. However, a range of explicit impediments must also be addressed.

2.2 Other impediments

While a typical cost-benefit analysis can show that agroforestry makes economic sense especially taking a "whole farm" approach, there remains a number of impediments that impede the growth of agroforestry at a large scale. Examples of such impediments are identified below (Commonwealth 1995; Alexandra and Hall 1998).

Lack of agroforestry culture:

- Australia does not have an agroforestry culture. Trees have often been viewed as an impediment to agriculture as they compete with traditional land uses and therefore their potential role as part of a productive landscape has not always been appreciated.

Lack of technical knowledge:

- Many practical questions of science and technology remain unanswered, including a capacity to quantify the flow-on benefits of different agroforestry options.
- Many farmers have poor technical skills in relation to agroforestry.

Lack of supporting knowledge system:

- The dispersal of R&D efforts has traditionally been across a diversity of organisations. There are few structured or formal means of cooperation, which further impedes the transfer of knowledge.

Market impediments:

- The unclear or conflicting role of state governments as both regulator and dominant wood grower can cause distortions in the market price of wood products.
- Landholders lack confidence that pricing mechanisms are transparent.
- Poor access to mills and log markets dominated by a relatively small number of large companies – landholders question whether they are subject to fair competition.
- Public dominance of wood production has, in the past, lead to an uneven playing field where private growers have had to compete against subsidised public forestry operations.

Economic barriers:

- Agroforestry has a poor public profile, which inhibits investment especially by institutional investors such as superannuation funds and investment managers.

- Establishment and maintenance costs are excessive, such as ground preparation, seeds or seedlings, planting, fertilising and fencing costs.
- Transportation costs of the harvest are high, especially where processing plants are not local.
- There is a long time until the investment is realised, however there are financial models to negate this.

Market Failure:

- Lack of clear market values for agroforestry environmental services; poor markets create a high risk to landowners.
- Inability to measure and capture non-market values, such as biodiversity protection, catchment integration, landscape aesthetics or CO_2 sequestration.

Public policy constraints:

- Historically, government policy settings have not been conducive to agroforestry.
- Confusing roles and responsibilities across spheres of government and between agencies creates policy confusion, as do inconsistencies and irregularities in local government land-use planning.
- The way that agroforestry is to be taxed remains unclear, including treatment of input costs, double taxation of royalty payments, profit a prendre, income averaging, and superannuation and investment schemes.
- Governments have generally failed to allow tree-tenure. This would permit ownership of trees that is distinct from the land they occupy.
- Lack of clear policies supporting management of private native forests.

Many of these issues have been recognised in both the National Forest Policy Statement (Commonwealth 1992) and the Wood and Paper Industries Strategy (Commonwealth, 1995). Progress has been made although issues undoubtedly remain. These issues are, however, well canvassed and will not be addressed in detail here.

3 TYPICAL INCENTIVES FOR AGROFORESTRY

3.1 Overview of the range of incentives

Figure 3 provides an overview of the range of instruments that can be used to implement policies for the management of native vegetation based on work undertaken for the LWRRDC/Environment Australia National Program on Rehabilitation, Management and Conservation of Native Vegetation (Binning and Young 1997, 1999a, 1999b, 1999c, 2000; Cripps, Binning and Young 1999). In this section of the report we evaluate the possible application of these incentives to address both the economic and institutional impediments to agroforestry identified in the previous section of the report. This 'toolbox' is divided into the following broad categories (Binning and Young 1997):

- **People** – the tools that can be used to motivate and retain landholder support for vegetation programs.
- **Finance** – the incentives that can be provided to share the costs of managing vegetation.
- **Security** – the regulatory, legal and voluntary property right instruments that can be used to provide secure adaptive management of vegetation.

These categories provide a powerful framework for evaluating policy instruments because there is considerable evidence that mixes of policies that harness the synergies between educational (people), regulatory (security) and economic incentives (finance) are likely to be more effective both in terms of cost and environmental outcome than the use of single instruments (Farrier 1995; Young et al. 1996; OECD 1996; Binning and Young 1997a, 2000).

This insight is critical because policy makers are generally biased to one type of instrument based on their disciplinary training and professional experience. For example, lawyers and planners tend to prefer regulation and land-use planning, economists incentive instruments, and social scientists education and participatory processes. A critical management issue in developing successful policy approaches is to bring these differing perspectives together and to seek out complementarity.

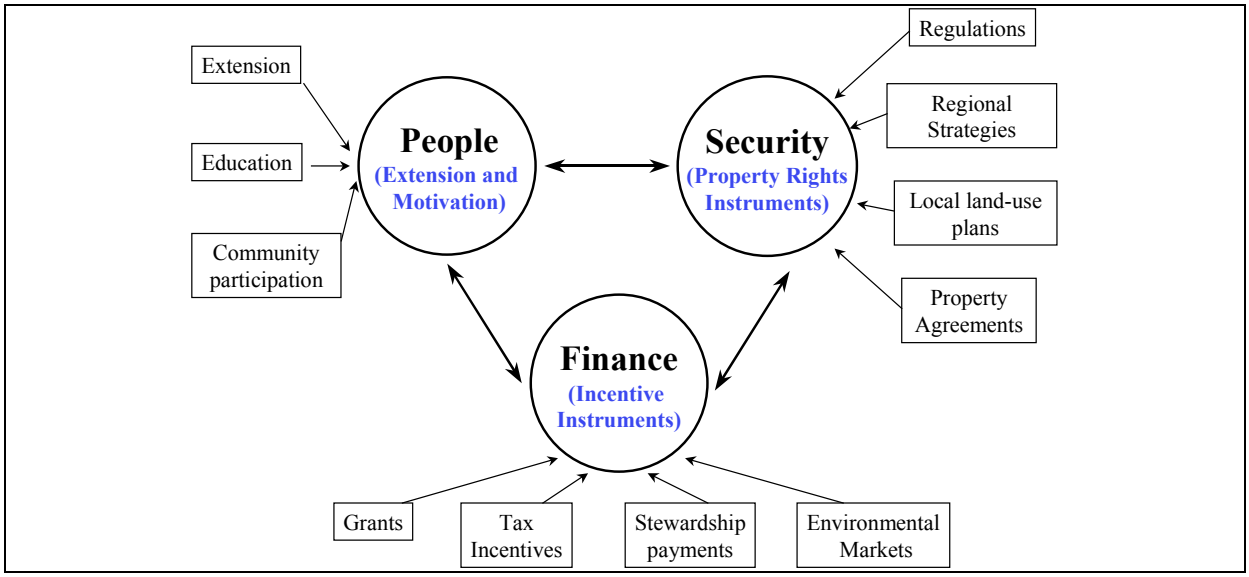


Figure 3: The policy mix (Binning and Young 2000).

One tangible example of the use of this policy framework relates to the issue of ordering policy development. Awareness raising through education is a critical first step, but is demonstrated to have

little influence on short-term behavioural change. Likewise, financial incentives are likely to be ineffective until awareness is raised and landholder attitudes shifted toward positive management of vegetation. Regulations have also been demonstrated to fail in the absence of strong community support (Brasden 1991). This suggests that an ideal policy approach involves: awareness raising to shift attitudes, financial incentives to assist in meeting the transition to more sustainable management, and regulations to secure the community's investment in improved management. Of course other policy approaches are possible in different circumstances, such as the use of incentives to promote acceptance of new regulations required to secure large structural changes in a short period of time.

In the remainder of this section the application of these tools to agroforestry is reviewed. This is then followed by an analysis of what can be expected from the application of existing incentives.

3.1.1 People: extension and motivation

Extension and motivation mechanisms are largely focussed on engaging landholders and communicating the potential benefits of agroforestry as a component of a farming business.

Models for landholder extension range from community/group based extension, such as through the Landcare movement, to one-on-one extension by individual extension officers.

A good example of an education and motivation program is the Farm Forestry Program funded by the Commonwealth Government (Commonwealth 1995)[1]. This program has a focus on:

- supporting landholder and community led initiatives, such as regional tree growers cooperatives, companies and networks;
- providing education, extension and training programs to deliver integrated advice to farmers, including property management planning;
- providing information and market development services;
- establishing strategic demonstration plantations;
- continuing development of national, state and regional commercial farm forestry strategies; and
- integrating farm forestry with other environmental and social objectives.

The Farm Forestry Program is attempting to address many of the impediments to landholder engagement and market creation highlighted in the previous section. Traditionally the program has retained a strong focus on the commercial viability of plantations on farms.

The farm forestry component is but one of a range of extension programs that address vegetation management and receive public funding. Different extension services generally focus on different policy objectives. These differences in policy objectives may result in conflicting messages being provided to landholders. At least four different perspectives are apparent:

> **Environmental Focus:** the focus of programs such as Bushcare, Land for Wildlife, and covenanting for conservation is on the protection of biodiversity.
>
> **Landcare**: the focus of the Landcare program has traditionally been on sustainable production. Key motivations for planting trees under these programs have been to address land degradation such as soil erosion and dryland salinity and to improve farm productivity through provision of shade and shelter.

[1] The Farm Forestry Program received funding of $18 million through the Wood and Paper Industry Strategy in 1995. Approximately $40 million in additional funding has been provided through the Natural Heritage Trust. The traditional focus of the program has been on facilitating on-farm commercial plantation development. In more recent years this focus has broadened to the role of agroforestry in low rainfall regions highlighting the need for mechanisms for combining the public and private benefits of agroforestry.

Agricultural Extension: Agricultural extension, traditionally provided by state agencies, has focused on issues of farm production such as cropping technologies, pasture management and animal husbandry. Extension of this kind is increasingly being provided by private consultants. A recent study has revealed limited scope to extend the interest of private farm consultants to sustainability issues in farm management (Dore et al, 1999).

Commercial Agroforestry: Private and State government forestry businesses are increasingly seeking to establish partnerships with rural landholders for the establishment of plantations. An interesting development in this area is the development of financial products that make investment in forestry more attractive to both landholders and non-landholder investors (See financial issues below).

The differing objectives of different extension programs are a significant issue because agroforestry is relevant to all of the programs, although not the exclusive focus of any. The need to coordinate the delivery of existing extension services was a major outcome of recent review of performance of Australian governments in vegetation management and monitoring (Dore, Binning and Hayes, 1999), which noted that continued effort is required to coordinate across the full spectrum of programs – ranging through commercial forestry, agroforestry, biodiversity and environmental plantings.

Considerable effort has already been made in this area and integration of different natural resource management objectives is a major driver behind the current development of the Natural Resource Management Strategy by Commonwealth and State governments. Significant issues remain however, particularly in disentangling the private and public benefits of agroforestry activities.

In addition to education and motivational tools focused on landholders, a second important set of tools relate to processes for broader community engagement (including urban Australians) to facilitate understanding of the benefits of agroforestry. For example, education on the environmental benefits of well-designed agroforestry may enhance the acceptance and willingness of non-landholders to invest in the provision of these public services either directly through markets for environmental services or indirectly through government programs. Another role is reducing conflict on the role of plantations through consultation processes involved in different regional/local planning instruments. A review of different types of community and education programs is provided in Binning and Young (2000).

3.1.2 Finance: incentives for agroforestry

As might be expected from the discussion of extension and motivational instruments, there is a range of different financial incentives for planting trees on farms, ranging from commercial plantings to grants for purely environmental activities. Financing mechanisms for different types of plantings are summarised below (Alexandra and Hall 1998):

Large-scale tree farms – industrial plantations: these are commercially driven industrial plantations which are often planted, owned and managed by the wood-using industries (domestic and overseas), or financed by them and grown on contract by governments and/or management companies. These plantations are financed in a number of ways from international or government joint venture, listed or prospectus companies, through to owner-manager financing. They are usually monoculture, boundary-to-boundary or fence-to-fence plantations, grown in this way to achieve necessary economies of scale.

In an agroforestry context this type of plantation also provides opportunities for landholders who wish to diversify their business and generate a future income stream. Innovative financial joint ventures or lease arrangements have been developed in recent years to attract landholders who wish to receive annuities and/or profit share.

Government-funded plantation expansions or joint ventures: in several States, governments are directly funding expanded plantations, or sponsoring their expansion through joint-venture initiatives. In the case of the latter, the State and the landholders jointly invest in plantations within designated regions with requirements for minimum areas, agreement on responsibilities, risks and profit share. Expansion of government-owned plantations or

government investments in joint ventures increases plantation production in the absence of, or as a substitute for, direct investment by capital markets or wood using industries.

Tax-driven or investment plantings: several companies offer tax-effective investments in plantation forestry. Investors gain tax benefits in the first year from investing in plantings aimed at generating future income. Management companies usually undertake the establishment and subsequent management. The principle behind investments of this kind is to offset high income with a large up-front investment and then to realise that investment after retirement when income falls. The long-term nature of forest investments makes them ideal for this type of arrangement. Hence, agroforestry is often promoted as a superannuation option for both farmers, institutional and private investors.

Whilst tax incentives in this area offer considerable incentive, there are a significant number of cases of poor management of managed plantation funds (TimberCorp, 1996 in Alexandra and Hall, 1998).

Experimental and grant-driven demonstration and Landcare plantings: experimental and grant-driven demonstration and Landcare plantings include many tree-planting efforts focused on environmental outcomes but which may yield future timber. Funding for these kinds of plantings is usually provided on a 50/50 cost-sharing basis with the landholders. In excess of $350 million has been made available through the Natural Heritage Trust for grants that often include tree planting.

Integrated farm forestry, 'diagnosis and design' plantings, and specialist crop trees: diagnosis and design planning of agroforestry is based on an informed approach to achieving the complementary benefits of combining agriculture and forestry on one piece of land or within a catchment. They are aimed at bridging between environmental and commercial objectives. There are limited financing mechanisms for these types of planting with the main potential lying in government programs such as Farm Forestry and Bushcare. The difficulty, however, lies in their partially commercial nature, which makes funding more problematic.

Commercial disincentives and disentangling public and private benefits remain the key issues raised by the breadth of financing mechanisms for agroforestry.

3.1.3 Security: regulation and property right based instruments.

Figure 3 highlighted the need to achieve a secure regulatory environment for agroforestry investment at all scales ranging from national policy to property scale agreements and land zoning.

As a starting point, it is important to note the potential conflict between different policy objectives that impact on agroforestry.

- From an environmental perspective it is important that vegetation management and clearing be regulated to ensure that an appropriate balance is struck between production and conservation. This means maintaining a well designed landscape where tree cover is maintained. The rationale includes both the intrinsic values of biodiversity but also the ecosystem services provided by vegetation including inputs to production, such as pest control and stock shelter and landscape scale processes such as salinity management.
- From a commercial viewpoint there is a need for regulations to provide a secure environment for investment in farm forestry. Factors include things such as removal of export controls on wood and paper products produced from plantations through to securing harvesting rights for farm plantations and private native forests.

These two different policy drivers are often seen to be in conflict with one another, for example in the case of uncertainty over harvesting rights (Commonwealth 1995). However, opportunities for synergy may also arise for agroforestry where environmental regulations place a cap on the use of environmental services. An example may be the introduction of rules for achieving "no net loss of biodiversity" within a catchment that would require investment in agroforestry to offset the

environmental impacts of clearing elsewhere in a catchment. Another example is the potential for agroforestry to operate as a carbon sink.

Table 3 summarises some of the key legislative and regulatory issues from both and wood production (plantations) and environmental perspectives. The need to establish regulatory regimes at different scales from each of these perspectives is well understood – the list is neither innovative nor new (see for example ANZECC 2000; Dore, Binning and Hayes 1999 and Commonwealth 1995). However, the potential for synergies between regulatory structures relating to plantations and native vegetation management are explored in the third column of the table. With good integration, particularly at regional and local scales, it should be possible to combine these two streams of regulation and create a conducive environment for investment in agroforestry.

Table 3: Key regulatory and property right issues from different perspectives and scales

	Plantations[2]	**Native Vegetation Management**	**Synergies with Agroforestry**
National	• Removal of Export controls on plantation timber • Tax impediments • 2020 Vision to treble plantations	Environmental Protection and Biodiversity Act • Issues of national significance: endangered species, wetlands, climate change (soon) • National Vegetation Management and Monitoring Framework	National framework for investment in agroforestry as a provider of ecosystem services
State	• Codes of Forest Practice • Separation of ownership of plantations and land • Harvesting rights	• Vegetation clearing controls • Catchment management planning	Development of regional plans with clear goals and targets for environmental remediation to • Provide certainty for agroforestry investments • Provide framework for investment in ecosystem services
Local	• Integrating plantation establishment into local planning schemes	• Ensuring protection of environmentally significant areas through local planning schemes	Development of planning regimes that integrate environmental protection and plantation establishment at regional and local scales
Property	• Legislation to allow joint venture arrangement and other investment vehicles	• Capacity for government and non-government organisations to enter statutory conservation covenants with volunteer landholders	Statutory mechanism to allow ecosystem goods and services to be separated from land ownership (eg carbon credits)

It is possible that laws designed to protect biodiversity or prevent the clearance of native vegetation may act as a disincentive for the development of agroforestry. However, Dames & Moore (1999) found that in general it appears that laws and policies in most states and territories do not lead to unfair disincentives for agroforestry. The possible exception to this is NSW, where the biodiversity-related laws involve time-consuming application procedures that some forest growers consider an impediment.

[2] Note that the legislative impediments shown here are mainly derived from the Wood and Paper Industry Strategy (Commonwealth 1995). Many of these impediments have been addressed.

3.2 What can we expect from existing incentives

The tools described in the previous section roughly summarise the existing approach to incentive design for agroforestry. An important question is what can be expected from traditional incentive-based approaches.

To some extent existing approaches are effective in achieving their goals – that is, they encourage tree plantings, deliver environmental benefit (habitat restoration, landscape rehabilitation), and increase the uptake of more sustainable land uses, including agroforestry.

However, the rate of ecological change is slow and incremental. Regulatory mechanisms have inherent limitations in delivering rapid environmental benefit. Additionally, the range of motivations for investing in environmental remediation often limits uptake, despite a catalytic effect.

In Figure 4, a scale of incentives is shown. The traditional toolbox is an essential component of the policy mix. However it has delivered only adequate environmental benefit. Larger market based incentives are needed to be able to move rapidly towards ecological goals, such as increasing vegetation cover in a catchment.

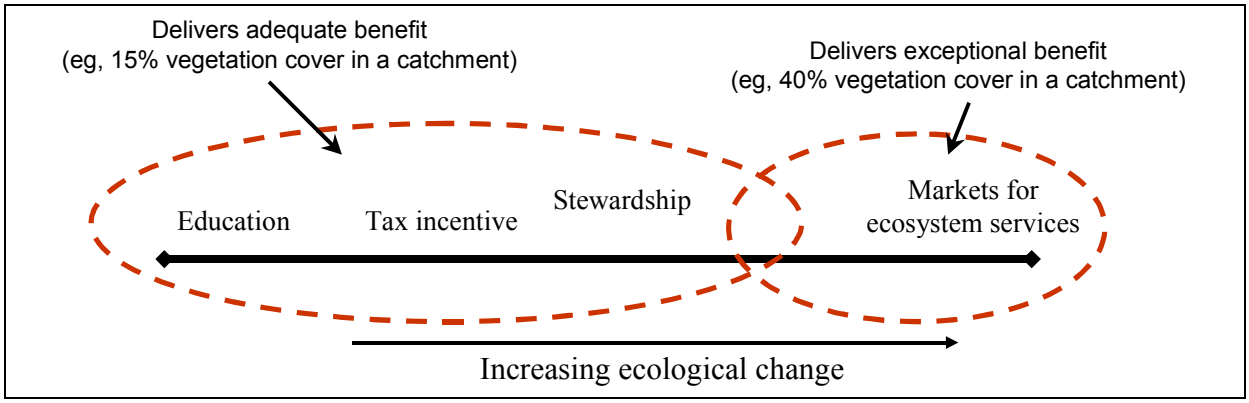


Figure 4: Scale of incentives for agroforestry delivering increasing ecological change.

The assertion made in Figure 4 is that existing mechanisms will not be sufficient to generate the radical transformation of landscapes needed in many of our catchments to address land degradation issues. For example, dryland salinity problems may require more than 30% of the landscape to be planted to trees. The traditional policy mix is likely to fail in such a goal. It may be successful in fostering community participation and partnerships over a 10 –20 year time frame to generate an incremental step – say from 5% to 10 – 15% vegetation cover. However, additional incentives will be required to move further more quickly.

The assertion is of course an empirical question. So what data is available? At a national scale, tree clearing continues to outstrip plantings as shown in Table 4. The table is interesting in that it reveals South Australia and Victoria as the only states experiencing a net gain in vegetation cover. Western Australia is experiencing gains if fire is ignored. These States are of course the most extensively cleared.

Regional data on the success of existing government programs is more difficult to obtain. In some leading regions, such as the Goulburn-Broken Catchment (Victoria) it would appear that existing initiatives have just succeeded in halting the decline of vegetation between 1993 and 1998. The region's vegetation plan ambitiously proposes to revegetate an additional 90,000 ha on public and private land by 2030 (GBCMA 1999). A key issue for the region is the development and funding of equitable cost-sharing arrangements.

Table 4: BRS/ALCC project: Annual rates of Change in Woody Vegetation (ha) 1990-1995[3]
(Bureau of Rural Sciences preliminary data, www.brs.gov.au/land&water/landcov/alcc_results.html)
(Woody vegetation defined as >2m tall, with >20% crown cover)

	Agric	Grazing	Other	Forests	Plantations	Farm trees	Fire	Total	
DECREASE									
ACT	-	-	-	50	1,100	-	-	1,150	
NSW	14,150		2,250	4,170	1,780	NR	33,520	55,870	
NT	1,180	220	1,920		-	NR	NR	3,320	
Qld	10,880	245,060	7,510	1,050	3,520	NR	40	268,060	
SA	1,280	NR	90	-	1,970	170	13,780	17,290	
Tas	40	820	80	5,700	1,700	250	260	8,850	
Vic	1,790	NR	660	6,270	4,480	NR	4,170	17,370	
WA	17,750	NR	3,400	1,610	600	NR	32,650	56,010	
Total	*47,070*	*246,100*	*15,910*	*56,460*	*14,151*	*420*	*84,420*	*427,920*	
INCREASE									***NET***
ACT	-	-	-	-	446	-	17	463	*-687*
NSW	307	8	27	1,482	7,680	34	4,014	13,552	*-42,318*
NT	85	-	-	-	31	-	-	116	*-3,204*
Qld	-	30,615	-	332	4,445	-	-	35,392	*-232,668*
SA	3,417	-	-	-	4,685	332	40,878	49,312	*32,022*
Tas	26	-	13	320	4,696	48	-	5,103	*-3,747*
Vic	-	-	612	2,772	7,001	1	36,136	46,522	*29,152*
WA	15,718	-	2,091	1,122	6,430	2,290	12,961	40,612	*-15,398*
Total	*19,553*	*30,623*	*2,743*	*6,028*	*35,414*	*2,705*	*94,006*	*191,072*	
Net	*-27,517*	*-215,477*	*-13,167*	*-50,432*	*21,263*	*2,285*	*9,586*	*-236,848*	

*NR = not recorded

Given this record, what has been achieved through existing approaches to incentive and policy design? The view we take is that existing mechanisms are necessary but not sufficient to promote agroforestry as a major land-use in Australia outside high rainfall regions.

It is important to remember that mechanisms within the policy mix, such as education and financial incentives, that build consensus and the capacity of local institutions to independently manage, within an adaptive approach, are still required when market-based mechanisms are introduced. There is little point in stopping education and expecting markets to take over.

Having said this it is important to look to the potential for markets to provide larger and more carefully targeted incentives for agroforestry. It is to this issue we now turn.

[3] The figures only address woody vegetation (as defined). Changes to grasslands, woodlands where crown cover is <20%, open woodlands, heaths and most shrublands have not been assessed. Significant threats to many ecosystems, such as grasslands, are not reflected. Despite the limitations, it is still the best and most recent overview available.

4 ECOSYSTEM MARKETS

Treating environmental improvement as a business or commercial product has the potential lead to greater returns and lower costs, for the environment as well as the economy (Quinn and Quinn 2000).

The focus of this chapter is to assess the potential to create markets for the environmental services provided by agroforestry. Key examples of these services include carbon sequestration, water purification, control of ground water recharge (salinity) and the conservation of biodiversity. Providing a direct financial return for the environmental values provided by agroforestry has the potential to complement and supplement the commercial viability of tree planting, particularly in low rainfall regions.

There are of course other strategies for increasing the commercial viability of agroforestry operations including the development of new tree products such as eucalyptus oil, activated carbon and bio-energy. These are being considered in other projects funded through the Joint Venture Agroforestry Project.

It is not envisaged that markets for environmental services will ever be the sole "driver" for agroforestry. Rather the potential for these markets lies in their ability to "top-up" existing returns that may not otherwise provide an adequate financial return.

Figure 5 sets out a conceptual framework for how ecosystem services may track through to commodities and markets in the future.

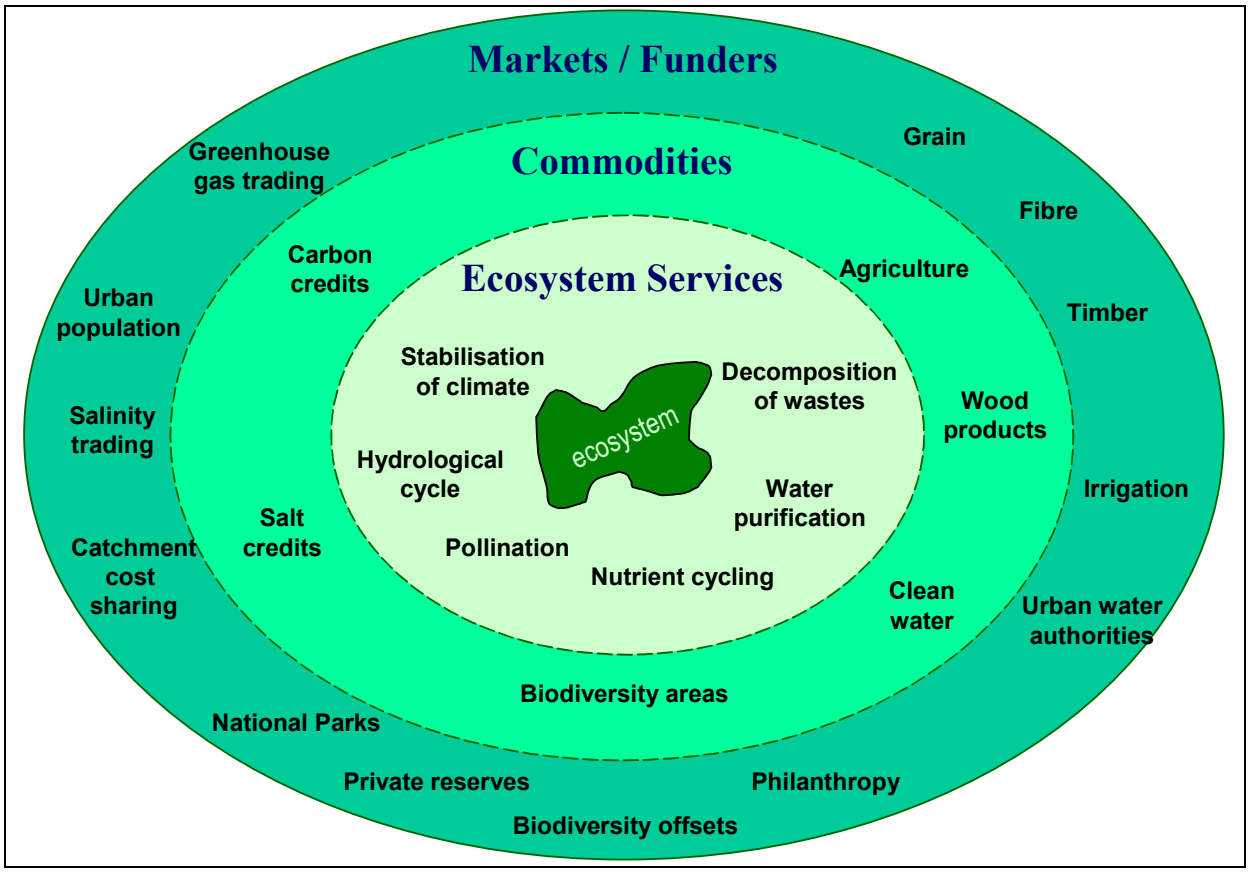


Figure 5: Linking ecosystem services to commodities and markets in the future – conceptual framework. Benefits flow from ecosystem services as commodities to markets. Markets are only well defined for a sub-set of these commodities (those on the right-hand side).

Figure 6 shows that there are multiple benefits flowing from the provision of ecosystem services that are inputs to a variety of commodities and markets. Markets are only well defined for a sub-set of these commodities, including timber and agricultural commodities. However, as has been discussed markets for environmental services are less well defined. The result is an inappropriate mix of land-uses in our landscapes.

To design and create markets for those commodities on the left-hand side of Figure 6 is a major challenge. A particular challenge is to harness the multiple benefits of agroforestry. In low rainfall regions it is unlikely that the returns from any single commodity will be sufficient to secure large scale investment in agroforestry. For example, it is estimated that carbon credits may be worth up to $40 per tonne in the future (Shea 1998). This will provide an important supplementary source of income, however, it will not be sufficient to sustain a viable farm business. So, there is a need to have mix of ecosystem service markets including "carbon", "water", "salt" and "biodiversity" to supplement the existing mix of timber markets.

4.1 A conceptual framework

The dynamics of creating successful markets for environmental services and commodities are, not surprisingly, complex. Several models have been put forward suggesting mechanisms that would deliver an efficient and equitable system that delivers maximum ecological benefit (see Appendix 4).

To begin, a simple conceptual framework for a market in environmental services is presented in Figure 6.

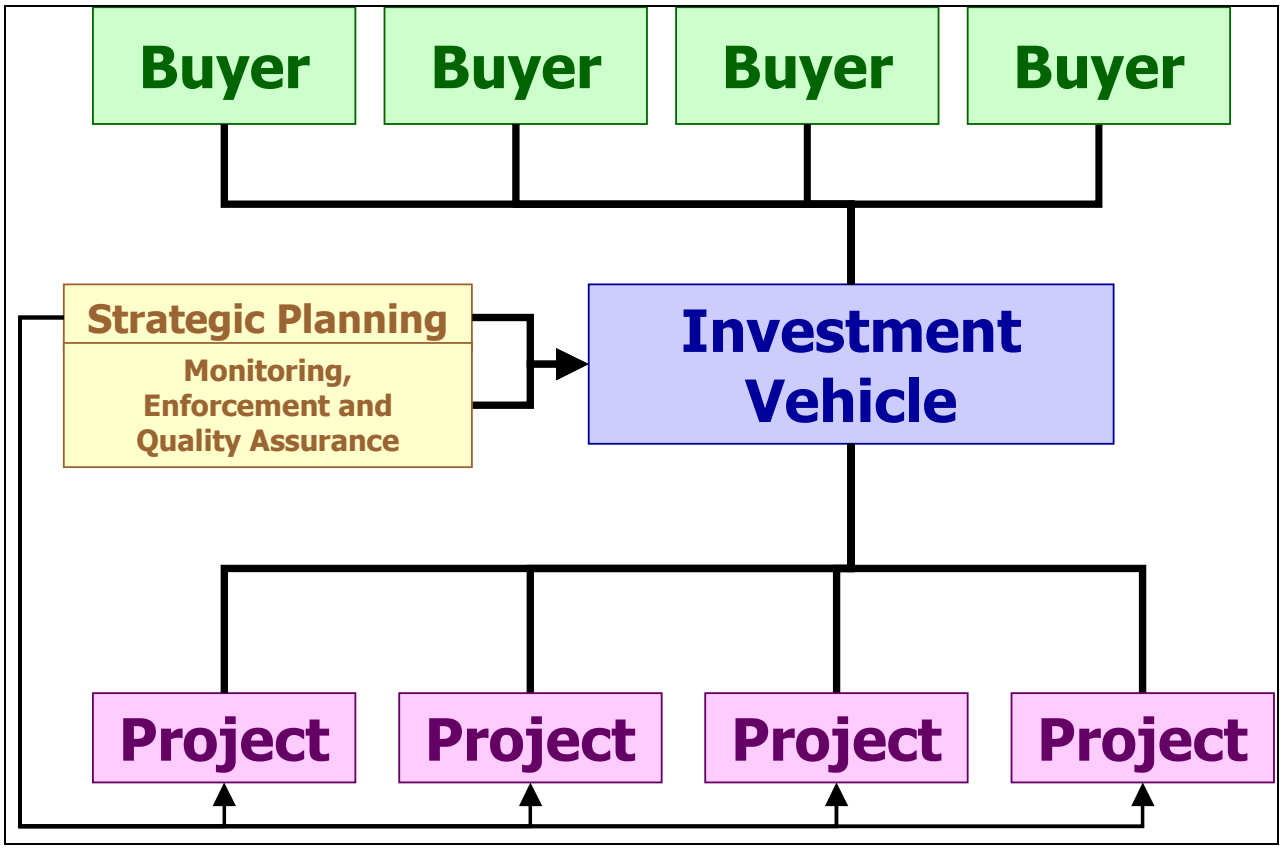


Figure 6: Conceptual framework for creating an efficient and equitable market for environmental services and commodities, which delivers maximum ecological benefit.

Figure 6 comprises three main agents: Buyers, Projects and an Investment Vehicle. Operational requirements include linkages to strategic planning that ensures appropriate landscape design and appropriate accreditation, enforcement and monitoring mechanisms.

Buyers are required to create a demand for ecosystem services or commodities through the provision of financial capital. Buyers may represent a company interested in purchasing carbon credits; or perhaps an organisation supplying funding for the protection of biodiversity values. Buyers will have different motivations for providing funding, such as philanthropy, landscape restoration, "right to pollute", or corporate image. Governments are, of course, the most significant existing buyers of ecosystem services through environmental programs such as the Natural Heritage Trust.

Projects are required to deliver ecosystem services to buyers. Projects are the sellers of ecosystem services. In the context of this study, landholders undertaking agroforestry operations that have environmental benefits are the projects that deliver ecosystem services. This provides an additional economic return for an enterprise. For example, a landholder may sell carbon credits to a company, salt credits to a landholder upstream, or biodiversity credits to a philanthropic investor.

Finally, a link between buyers and sellers is required. This is the investment vehicle, which is able to draw on many funding sources (buyers) and distribute financial capital to projects. In return for funding, projects provide one or more ecosystem services.

The investment vehicle is also needed to ensure efficient and strategic trading is occurring. Strategic trading ensures that individual projects are located in areas that contribute to meeting a region's strategic environmental objectives. A key challenge is ensuring input from catchment management authorities so that on-ground action is targeted in areas to gain high levels of environmental benefit. This requires environmental outcomes to be bundled and considered concurrently. For example, the location of tree planting for carbon sequestration would need to take account of impacts on salinity and water flows or risk a perverse outcome. A well designed investment mechanism has the potential to add discipline to regional planing processes and bring trades together, thereby significantly lowering the transaction costs of meeting environmental objectives.

At this point it is important to emphasise that the conceptual framework developed here is not focussed on privatising the environment or giving unfettered reign to markets. Governments can and do play a major role as: buyers, through natural resource management programs; sellers, on government owned and managed lands; and brokers, through strategic natural resource management planning. The role of government will indeed remain critical.

The hypothesis put forward here is that the use of market structures has the potential to test, improve and increase both government and non-government investment in agroforestry. Indeed a major finding is that irrespective of who invests, government or private interests, the key steps in market creation will facilitate more effective on-ground delivery and uptake of agroforestry by landholders.

In summary in whatever form, the buyer-investment-seller framework raises three significant questions:

1. How are **buyers** secured in order to create a demand for ecosystem services?
2. How are landholders engaged in **projects** to supply ecosystem services?
3. How are buyers and sellers linked (**investment vehicle**)?

To foster the growth of markets for environmental services a larger set of issues will of course need to be addressed. Research, standard setting and the regulatory functions of government will be critical (Quinn and Quinn 2000). Developing markets for environmental services requires enhanced science and data capabilities, sophisticated modelling systems, strong quality control and effective knowledge transfer mechanisms.

Following discussion of the key questions outlined above, a number of these operational challenges are discussed.

4.1.1 Securing Buyers: Creating demand for environmental services

How are buyers for environmental services to be secured? Demand may be created via a number of mechanisms. First, government investment creates a demand for environmental services. Second, voluntary investment may be secured through a variety of motivations. Finally, private investment may be secured through government regulation. These three approaches to attracting buyers of environmental services are discussed below.

Government investment

Governments are presently the most significant investors (buyers) of environmental services through grants or direct investment. The Natural Heritage Trust is perhaps the best-known example.

Difficulties arise due to obvious limitations in government spending for the large task of funding an adequate number of projects that deliver ecosystem benefits. For example, recent analysis has clearly demonstrated the inadequacy of existing responses to salinity management despite significant government investment (MDBC 2000; PMSEC 1998). The targeting of investment is essential (Stoneham and Chaudhri 2000). A key issue for governments is how to prioritise environmental spending. This will require:

- **Targeting priority areas** - difficult choices need to be made regarding the relative costs benefits of investment in different projects depending on the status, threats and options for rehabilitation of ecosystem services in different locations within a catchment;
- **Targeting across multiple environmental objectives -** the implications of individual projects on different environmental issues needs to be quantified and ranked so that projects will yield the highest net environmental outcome will receive priority; and
- **Targeting alternative funding sources** – increasingly governments will need to supplement government investment by effectively leveraging non-government investment.

Addressing these issues represents a significant challenge to the administration and targeting of existing government programs for natural resource management. The challenge has been recognised and is beginning to be addressed through the development of the National Action Plan for Salinity and Water Quality that has recently been endorsed by the Council of Australian Governments (COAG, 2000). For example, the National Action Plan for Salinity and Water quality has commited governments to establishing targets for salinity and water quality, with additional targets for biodiversity to be developed at a later time.

Voluntary Non-Government Investment

Voluntary action currently remains the dominant reason for private sector investment in environmental services. Motivations for investing in environmental services include:

- **Philanthropic**: investment by a person or a company who donates time and/or money to the environment - for altruistic reasons and/or personal fulfilment. This sort of investment is usually unconstrained but is usually aimed at demonstrating or catalysing activities that will "make the world a better place".
- **Socially Responsible Investment**: investors in capital markets are increasingly looking to performance across the "triple bottom line" when deciding where to invest (Allens Consulting, 2001). Thus there is a small but growing market for projects that are able to demonstrate their social, environmental and financial performance.
- **Corporate identity**: a marketing tool used to promote a corporation's good image. Often these sorts of investments are used as a trust of good credit. If a corporation receives bad press it will draw on some of it's good credits to keep up a good company profile. Corporate identity investors will be strategic about choosing their investment and will demand more from the investment than a purely philanthropic investor.

- **First movers:** corporations may move to participate in markets in order to influence their development and thereby have a role in defining how this type of investment will be conducted in the future and get a head start on creating efficiency and enhancing their market competitiveness.
- **Self-regulation**: corporations may invest in addressing environmental problems before the need for regulation, for example through the development of voluntary codes of practice. Along with the first movers, these investors will try and help define where the market is currently at and how it will be conducted in the future. By setting the standards on what they are likely to achieve in the future investors hope to avoid future regulation that may negatively impact on them. This is a form of risk management.
- **Cost minimisers**: In some cases it may be more cost effective to invest in the maintenance of natural assets rather than investing in technological substitutes. A good example is urban water authorities who are increasingly investing in the management of natural resources in their catchments in order to lower water treatment costs (Binning, Cork, Shelton and Parry, 2001). As highlighted in Chapter 2, agroforestry operations may fall into this category where the on-farm benefits of well designed agroforestry often exceed the costs although these benefits are often difficult to quantify.

A key challenge in securing a greater voluntary investment in environmental services is in linking action to benefits – that is, being able to account for benefits derived from individual investments. The greater the certainty of a project securing the desired outcome, the easier it will be to find investors.

Voluntary action may play a critical role in the establishment of new "emergent" markets. However, voluntarism is unlikely to be sufficient in the long run as it does not address the underlying issues of market failure. Fully mature markets will not emerge until governments move to regulate the use of environmental resources that are public goods (ie their consumption is non-excludable).

Regulating the system - Placing limits on the use of natural resources

To secure desired environmental outcomes governments may regulate resource use to ensure environmental thresholds are not passed. By placing a limit on resource use, scarcity is created, demand is increased and a commercial value for environmental services created.

Regulations may be applied universally, applying the same standards or requirements on all resource users. Alternatively regulations can be used to set an overall cap on resource use and then allow rights to that resource to be traded to achieve efficient allocation between competing resource users (Young and Evans 1997). Tradable water rights and fishing rights are examples of market-based mechanisms that are actively being used to regulate resource use in Australia.

Cap and trade models can be envisaged for other environmental resources. For example, a cap on vegetation clearing may require people seeking to clear vegetation on their land to purchase "biodiversity credits" of equivalent or higher value. Once a currency for trading is established the market (ie buyers and sellers) will define the financial value. Obviously the more restrictive the resource use cap, the higher the scarcity will be, and hence the value of any environmental credits will be higher. Sulphur Dioxide Emissions trading in the US is an example of a cap-based mechanism.

A cap must be set through legislation. Once a cap has been set, allocating credits to existing resource users is perhaps the most difficult policy issue. Methods can vary, encompassing auctioning, 'grandparenting' based on past resource use and other options (Sonneborn 2000). Rights can be defined as a percentage of a total allowable limit thereby providing greater scope to adapt the system though time.

From an environmental perspective the critical part of this process lies in establishing an appropriate cap on overall resource use. The market mechanism is somewhat incidental to the outcome, although it may facilitate efficiency, structural adjustment and acceptance of the program. A challenge associated with tradable permit schemes is to ensure that there is capacity to refine and adapt the regulatory cap through time as scientific knowledge and community values change.

This adaptability is particularly important as tradable permit schemes are often introduced as a measure of last resort once significant degradation of a key resource is already occurring. In these cases it may be important to gradually restrict overall allocations over a number of years until sustainable levels of use are re-achieved.

Chapter 5 provides some examples of cap and trade and offset regulations operating in both Australia and overseas.

In summary, government and voluntary investment are likely to remain the primary motivations for investing in environmental services in the short to medium term. However, it is emphasised that ultimately a regulatory role must be introduced to limit resource use or cap outputs, such as carbon emissions or salt. Such caps create scarcity in the marketplace and hence demand. As noted, recent moves to set targets through the National Action plan on Salinity and Water Quality are encouraging.

4.1.2 Identifying Sellers – Securing supply of environmental services from landholders

In any market, trading is used to identify those people who are able to supply goods of a given quality at the lowest price. Markets for environmental services are no different, raising two key challenges.

- First, identifying those landholders with the highest willingness to undertake agroforestry.
- Second, identifying those actions and projects that are going to yield the best environmental outcome.

Landholders have a range of motivations for investing in agroforestry ranging from commercial to intangible benefits. Further, the location and type of land available will affect the cost to landholders of providing environmental services. Thus, some landholders will be able to supply environmental services at a lower cost than others. The challenge is identify those landholders willing to supply environmental services at least cost.

There are a number of different approaches to engaging landholders and providing payments for environmental services. These approaches are summarised below. Appendix 2 provides a more comprehensive discussion of the relative merits of different approaches.

Catalytic incentives - Catalytic incentives seek to work with the most willing set of landholders to demonstrate the benefits of agroforestry. It does so for two reasons: first, to obtain maximum benefit for scarce funding for incentives; and second, to achieve a demonstration effect – that is to increase the willingness of other landholders in the future.

Catalytic incentives are characterised by a relatively low level of incentive payment, however it is hoped that, through increased awareness of the multiple benefits of agroforestry, a shift in landholder willingness can be achieved. A catalytic approach to incentives could perhaps best describe the rationale behind incentive payments under the Landcare and Natural Heritage Trust programs. Emphasis is placed on education and raising the profile of planting trees on farms with a view to increasing participation through time. This approach can be effective up to a point. However, if a higher level of participation or more targeted investment is desired then larger incentives will be required.

Cost sharing (beneficiary pays) - Another approach to calculating incentive payments is the use of cost sharing principles as advocated by the Murray Darling Basin Commission (1996). Under this approach payments are made on the basis of the beneficiary pays principle. This means that incentive payments are made on an estimate of the public benefits associated with tree plantings. One example is the Coorong and Districts Local Action Plan (1997) where incentive payments vary from $250 per ha for plantings with only a salinity benefit to $400 per ha for plantings using local species that have a biodiversity and salinity benefit.

A consequence of the cost-sharing approach is that all plantings of the same environmental benefit receive the same payment. Such an approach is equitable but may not be as cost effective as other strategies such as auction systems.

Equal pay for equal work - Equal pay for equal work requires that the same payment be made for the same level of work. It is similar to a cost-sharing approach with the important exception that payments do not vary with environmental benefit. An example would be a fixed incentive per hectare of plantings irrespective of environmental benefit. Many existing grants programs take this approach such as fencing assistance provided at $1,200 per km under the Bushcare program – although environmental benefit may be used to rank proposals for funding.

Auction systems: extracting private rents - An auction system, as proposed by Stoneham and Chaudhri (2000) seeks, through an auction to secure projects of the highest environmental benefit at the lowest cost. It does this by requesting that land managers place bids on the level of payment they require to invest in planting trees. In theory, each landholder will bid the lowest acceptable price meaning that the revenue costs can be minimised.

Well designed auction systems have the potential to match high priority environmental projects with the most willing landholders. However, projects of the same environmental value may receive different payments depending on the bids made by different landholders. Thus the scheme has the potential to achieve greater cost effectiveness but with reduced equity between landholders.

Auction systems have not been used in Australia although they are soon to be trailed by the Department of Natural Resources in Victoria (Stoneham, pers.com). One concern is that in the absence of complementary education and regulatory mechanisms, an auction system of this kind may fail to effectively engage landholders and may undermine the catalytic effect of demonstration and education.

The different approaches to targeting landholders (sellers) have different strengths and weaknesses. The relative merits of different approaches are dependent on two factors:

- First, the effectiveness of each approach in achieving its objective, for example in engaging landholders (catalytic approach) or achieving least cost outcomes (auction systems); and
- Second, value judgements about the relative importance of different design criteria particularly cost effectiveness, equity and administrative cost.

Determining the relative effectiveness of different approaches is an empirical question. Little data is available to test this question. As has been noted, a wide range of factors affects uptake by landholders of different schemes. What, for example, has been the effectiveness of the Landcare program in creating a catalytic effect, raising landholder awareness and thereby achieving greater uptake of agroforestry? The success of fully commercial agroforestry operations can be assessed. However, as discussed, the uptake and effectiveness of tree plantings planted for mixed motivation are more complex. Indeed, the Auditor General in reporting on the performance of the Natural Heritage Trust has noted the difficulty in measuring the effectiveness of programs with multiple objectives including community engagement and education (Commonwealth Auditor General, 2001).

What can be said is that a number of factors have the potential to raise the environmental performance and reduce the cost of payments to landholders for the supply of environmental services:

- First, a mix of education, regulation and incentive has the greatest potential to shift attitudes and hence willingness to invest in tree planting on farms (catalytic approach);
- Second, auction systems are potentially the most cost effective way matching motivated landholders with high value environmental projects; and
- Third; targeting payments to environmental benefit allows funding to be distributed to those plantings of highest public value (cost-sharing approach).

This discussion has served to highlight the complexity of designing payment methods and the associated challenge of engaging landholders to secure agreements for the provision of environmental services. The challenge is to raise landholder participation without raising expectation of large increases in the level of payment for environmental services.

Markets for environmental services have the potential to achieve this outcome if well designed and linked to adequate regulations and environmental accreditation systems.

4.1.3 The investment vehicle – How are buyers and sellers linked?

Linking buyers (investors) with sellers (landholders) that are to sell environmental services requires an intermediary investment vehicle. Essentially, an investment vehicle attracts financial investment to a pool of ecosystem credits that would flow from strategic on-ground projects, such as agroforestry, landscape rehabilitation, and other land-use or management changes.

In the context of environmental benefits and agroforestry, an investment vehicle would be successful if it was able to market the benefits of a set of agroforestry operations to investors who are currently not engaged in the purchase of services from the land managers concerned.

Agents are required to make formal links between buyers and projects. Conceptually, an accredited broker acts as an intermediary between the contracting parties and receives a brokerage fee for services rendered. For example, most carbon sequestration contracts that are currently taking place involve brokers. The broker facilitates trade of specific proprietary interests in carbon sequestration from a landholder to an emitting firm, but in no cases enters into a position of ownership of a property right. For example, State Forests NSW has acted as the broker, selling carbon sequestration rights to companies. Generally, brokers act as an intermediary, tailoring products to suit interested investors.

Dealers differ from brokers because they acquire proprietary interests from landholders, pool these rights into a product likely to be of interest to third parties, and then on-sell these rights. Dealers can play an important role because of their capacity to pool the relatively small ecosystem benefits that arise form individual projects. For example, a group of 30 landholders in a catchment may undertake various projects, such as agroforestry or landscape restoration, each delivering relatively small quantity of ecosystem benefits. Negotiation with each of these landholders is unlikely to be of interest to a large investor. However, an investor might well be interested in working with a dealer that can pool benefits and on-sell them

An “investment vehicle” is difficult to define because there are many different ways in which buyers and sellers can be linked. These alternative mechanisms have different information requirements and different levels of risk and security associated with their operation. A number of approaches to brokering investment in natural resource management outcomes are currently being trialed or debated including:

- The Australian Bush Heritage Fund and a number of other conservation organisations have established markets for direct investment in biodiversity conservation. Individuals donate/invest funds and these are used to purchase land of high conservation value that is then managed in perpetuity for conservation. In this model the investor has assisted in securing a shared objective. However the investor has no ongoing rights to that outcome making the investment largely philanthropic in nature.
- The Murray Darling Basin Commission in collaboration with a number of organisations has proposed the establishment of Vegetation Bank. The Bank would invest scarce government funding (sourced from climate change and natural resource management programs) in forestry operations that make a strategic contribution to meeting salinity and water quality objectives. Its objective would be to only supplement investments to the point where they become commercially viable. An auction based system may be used to maximise cost effectiveness and ensure effective targeting.
- In a pilot program NSW Department of Land and Water Conservation has called for expressions of interest from 20 landholders who will be required to sign contracts for the

delivery of environmental services. It is likely contracts will need to be prepared prior to techniques for quantifying the environmental benefits are finalised. Hence, an approach to risk management, learning and adaptation will be required.

- The Allens Consulting Group (2001) have identified poor access to financial and capital markets as a major impediment to commercial investment in land-use changes that have both environmental and financial benefits. Access is denied because the investments are inherently risky and loans sought by landholders are often too small to be of great interest to financial institutions. They propose that government establish a fund that will lend funds at low competitive rates for land-use changes that secure improved environmental outcomes. In return landholders would be required to achieve accreditation that ensures that improved environmental outcomes are delivered.
- The Sydney Futures Exchange had proposed to establish a carbon trading desk that would allow both brokers and dealers in carbon credits to trade on the basis of a range of verification and quality assurance processes.

Each of these examples seeks to fill a perceived gap between buyers (be they public or private) and sellers of environmental services. Because of the entrepreneurial nature of brokering between buyers and sellers it is difficult to define the exact attributes that a investment vehicle should have. A set of general attributes include (Young and Evans, 1997):

- Rights of receiving or selling ecosystem units or "credits" are fully specified, including a definition of a credit, entitlements and obligations;
- Trading arrangements are rule-based with a periodic review mechanism that does not compromise investment or financial security;
- Administration, monitoring and enforcement costs are as low as possible; and
- Transaction costs for investors, brokers, dealers and landowners are low.

This is a demanding set of attributes. In the next section a number of the challenges associated with these attributes are discussed in greater detail, for example techniques for quantifying and accounting for environmental benefits, contractual arrangements and quality assurance processes.

In any model a trade-off that needs to be carefully considered is the relationship between the costs associated with trading and the security or risk accepted by different parties. For example, it would be possible to purchase rights that have no legal standing but have standing in goodwill. Accepting some attrition, this may be still be more cost effective than requiring full security through complex legal, quality assurance and monitoring mechanisms.

Hence, investment vehicles can be designed in more or less complicated ways. At one extreme, if governments are the only buyer, simple incentive programs tied to strategic regional planning may be sufficient. What would be required is a capacity to pool funding from different government programs to fund the multiple benefits of agroforestry. Incentive programs in Coorong and the Goulburn-Broken are interesting because they do this and hence are able to provide larger incentives to projects that are strategic and have multiple environmental benefits (for example, see Coorong, 1997). At the other extreme, a fully-fledged market with regulatory caps and intermediary brokers could be envisaged in the longer term. A conceptual design of different investment vehicles is depicted in Appendix 4.

In summary, there is much to learn about the design of successful investment vehicles for natural resource management. A high degree of learning, experimentation and innovation would be a critical output from an initial investment vehicle before regulatory backing occurred to formalise a buyer-investment-seller framework. A number of the detailed operational requirements for functioning markets are discussed in the following section.

4.2 Challenges in creating markets for environmental services

The buyer-investment-seller framework raises a number of important policy design challenges. Market 'creation' is a difficult task and care must be taken to ensure that resources invested are carefully targeted. Outlined below are six key challenges. This is followed by a concluding sub-section that evaluates how a transition to markets for environmental services may be achieved.

The following challenges are considered here:

1. **Defining the Product**: to be able to sell ecosystem services it is necessary to define the service accurately using scientifically credible methods and data.
2. **Ensuring Markets are Linked to Strategic Regional Outcomes**: because actions need to be taken in specific locations in the landscape, markets will need to be linked to strategic plans that perform this function at an appropriate scale.
3. **Pooling Credits and Developing Markets Concurrently**: because agroforestry has multiple benefits there may be advantage in marketing different environmental outcomes to different buyers through a process pooling different ecosystem/environmental credits.
4. **Clarifying Property Rights**: once defined, rights to environmental services will need to be secured through appropriate legal mechanisms.
5. **Quality Assurance, Monitoring, and Risk Management:** processes for verifying and securing environmental outcomes over time will be required. Because of the long timeframes involved this is a substantive issue with interesting linkages to environmental certification.
6. **Removing Impediments to Non-Government Investment**: the non-government sector is currently impeded from participating the provision or purchase of a number of environmental services.

4.2.1 Defining the product

This section describes how an ecosystem credit may be represented in physical terms. Quantifying benefits derived from ecosystem services in terms of a single index (per commodity) or 'credit' is an important step for measuring progress against regional natural resource management targets. It also has the potential to facilitate market creation and trading. Counting does, however, represent a significant scientific challenge as the measure chosen must take account of scientific uncertainty and heterogeneity in the environment, and still have credibility in the market place. For example, measuring and monitoring carbon credits or biodiversity credits demands rigorous, efficient and practicable methods that are still being developed.

Carbon

While still under much discussion, the carbon credit is very much a reality in today's society. Australia is one of the first movers in seeking to establish an emissions trading program incorporating certified sinks, with permits issued in proportion to the volume of carbon sequestered (Sonneborn 2000). Generally, one carbon credit would equate to one tonne of "carbon equivalent" (CO_2-e) sequestered in a forest or plantation. Such credits would be tradeable instruments, and could be used interchangeably with emission permits in any emissions trading system.

Methods for counting carbon are advancing rapidly (Hassall and Associates 1996). The issue of calculating carbon credits is, however, not entirely straightforward (Kirschbaum 2000). Key issues relate to: the coverage of any scheme to all greenhouse gases, the inclusion of potential sinks (eg vegetation, soils). One approach to addressing these uncertainties, adopted by State Forests in NSW, is to manage a pool of carbon sinks (plantations) and then adopt a conservative approach by only trading in a proportion (say 60%) of the expected carbon sequestered. This allows a buffer for future developments in the negotiations (S Beil and D Brand, pers.comm, February 2000).

Current research by JVAP has produced a prototype of "The Carbon Farmer" model, which will help personnel in the field of forestry and agroforestry make carbon credit calculations for the particular situations that they encounter (Hassall and Associates, 2001). The Australian Greenhouse Office and CSIRO Forestry and Forest Products are conducting similar research.

Biodiversity

Biodiversity credits are yet to be developed although a number of organisations are working on such an accounting system. Because of its heterogeneity, biodiversity is very difficult to commodify. What for example are the trade-offs between natural habitat and revegetated areas? How should attributes such as size, connectivity and condition be combined into a single measure? These are not simple questions.

A number of groups have or are in the process of developing proposals for calculating biodiversity credits:

- The Department of Natural Resources and Environment (Victoria) (2000) has developed the concept of Habitat Hectares for ranking and evaluating the relative values of different areas of habitat within a region or catchment.
- Shields (in press) has proposed a commodity called a Bios, which would involve calculations based on a number of factors including conservation status, connectivity and stability.
- The New South Wales National Parks and Wildlife Service has initiated a major project to assist in defining biodiversity values through a credit ranking system.
- CSIRO has developed a number of tools for ranking and assigning relative values to different areas of native vegetation in different natural systems ranging from forests to rangelands. It would be relatively straightforward to develop accounting systems based on the following tools in three major biomes:
  - In intact contiguous areas of native vegetation (forests) tools such as TARGET (Faith and Walker 1995) and BIORAP (Margules and Redhead 1995) can be used to evaluate the relative importance of different areas to meeting conservation objectives such as comprehensiveness, adequacy and representativeness.
  - In agricultural regions where native vegetation is fragmented the focal species approach proposed by Lambeck (1997) provides a framework for assigning value to both existing vegetation and also for targeting rehabilitation works.
  - In rangeland regions the work of Landsberg et al (1997) demonstrates the potential effectiveness of surrogate measures such as distance from watering points as a measure of biodiversity value. Others such as Tongway and Hindley (1995) have proposed an approach based on landscape function through a trigger-transfer-reserve-pulse model.

The development of a biodiversity measure is an urgent task to provide focus to debate on the relative trade-offs involved in different management regimes. The role of agroforestry in conserving biodiversity is an interesting issue in its own right, particularly when used to re-establish tree cover in fragmented systems.

Salt

Currently salinity credits may be expressed as a percentage of the total allowable salt load in rivers and credit limits, which would be calculated for individual blocks of river systems. The Murray Darling Basin Commission (MDBC) has recently completed a major audit of river salinity and has used this as the basis for setting salinity caps for individual catchments (MDBC 1999).

Measures for dryland salinity are more problematic as it is difficult to link remediation works with outcomes quantitatively, spatially and through time. Although our knowledge is improving the capacity to link cause and effect, this remains the biggest issue in addressing salinity issues. Having

said this, much research has been undertaken into the salinity benefit derived from tree plantings (RIRDC 2000). This publication on trees, water and salt outlines the benefits of various planting strategies under different conditions, and could potentially be used as a basis for defining salinity credits.

Water quality

Water quality may be measured in many ways depending on location and purpose. Water quality trading may be conducted in a similar way to salt. One section of the river has a pollution cap with the emitters of the system having a proportion of the cap. One emitter is able to increase loads in exchange for reduced loads at another, while complying with reduced overall discharge limits.

Likewise water diversion is becoming increasingly regulated under trading regimes where water users are allocated a percentage share of the total allowable water diversions. Young and Evans (1997) have developed such a market mechanism to manage groundwater pollution.

4.2.2 Ensuring Markets are Linked to Strategic Regional Outcomes

Strategic planning at regional scales is required to generate clear goals and targets for economic, environmental and social outcomes. Any investment vehicle, or broker of ecosystem credits, will need to operate in the context of regional planning and national goals. The need for strategic planning and targeting is twofold.

- First, with scarce funding sources for natural resource management there is an urgent need to give priority to projects that deliver across a range of environmental objectives concurrently.
- Second, to avoid perverse outcomes – for example, in the case where agroforestry operations planted for carbon sequestration inadvertently reducing stream flows and hence concentrations of salt, nutrients and pollutants in waterways.

The process of strategic planning requires that clear objectives for natural resource management are established and targets that can be measured in biophysical terms established. The contribution of different on-ground works to meeting these objectives then need to be quantified. In the future it may be possible to remotely assess the contribution of different actions at fine spatial scales through Geographic Information Systems. However, at present it is likely that broad regional priorities will need to be combined with site visits to verify the contribution of proposed works.[4]

A process of accounting for environmental benefits and clear strategic planning could ultimately lead to catchment planners being able to articulate a clear set of catchment targets of the kind set out in Table 6.

Table 6: Examples of catchment targets

	Carbon	Biodiversity	Salinity Mitigation	Water Quality
Catchment Target	Tonnes of CO2	% of pre-european vegetation	EC at end of valley	Nutrient levels

[4] Site visits are also important in creating a social dynamic between scientists and/or extension staff and landholders that enables projects to refined to become more strategic.

The more challenging task will then be to evaluate the relative contribution of different on-ground projects to meeting catchment targets and then relating this to an appropriate ecosystem credit. Ultimately, it can be imagined that a relative ranking of different projects of the kind set out in Table 7 could be developed.

Table 7: Hypothetical ecosystem credit ratings of different projects with reference to catchment targets

Alternative Projects	Carbon Credit (Tonnes of CO^2)	Biodiversity (% of Vegetation Community)	Salinity Mitigation (End of Valley EC)	Water Quality (Nutrient Level)
Commercial Agroforestry	10	-1	Medium	3
Mixed Benefit Plantings	5	5	High	10
Biodiversity Plantings	3	10	Negative	6

In the table different projects contribute to different environmental targets to differing levels. The rankings in the table are hypothetical and will vary depending on the nature and location of the project in the landscape. It is important to note that projects may have a negative outcome for some environmental objectives, underscoring the need to account for the impact of projects across multiple environmental objectives.

It may not be possible to precisely quantify the level of all projects to all environmental targets. However, some relative ranking should be possible, for example in the case of salinity credits the table reflects that it may only be possible to rank actions on a high/medium/low basis. The issue of adapting the system of accounts as scientific knowledge improves and catchment plans are refined is discussed below.

The capacity to quantify environmental benefits in reference to a credit system that is tied to strategic catchment planning that inturn defines catchment targets is a fundamental building block for the development of effective markets for environmental services.

4.2.3 Pooling Credits and Developing Markets Concurrently

A key challenge in the creation of markets is to be able to effectively bundle and/or pool the funding provided by investments in different environmental services. To date purchase of environmental services has generally been limited to a single "deal" which is tied to a single environmental benefit, thereby limiting the total level of funding and the size of incentive available to specific projects.

For example, the first carbon and salinity trades in Australia have been recently negotiated by State Forests of NSW in partnership with the Sydney Futures Exchange (carbon) and Macquarie Food and Fibre (salinity) (Smith 2000). In both of these cases the beneficiaries of ecosystem services have been provided a market through which they can invest in on-ground works. The carbon example is particularly interesting as companies seek to hedge risk associated with the Kyoto Protocol by investing in carbon sinks.

The challenge is to create a framework through which the multiple benefits of agroforestry and other on-ground programs can be realised. For example Table 8 shows that in the future a viable agroforestry enterprise could potentially maintain a larger commodity portfolio.

Table 8: Example of potential returns to an agroforestry operation and clients.

Commodity	Share of farm business	Potential Client
Wheat	35%	World Market
Wool	15%	World Market
Timber	25%	Specialty and World Market
Carbon Credits	10%	Steel Company
Salinity Credit	5%	Catchment Management Authority
Water Filtration Credit	7.5%	Urban Water Authority
Biodiversity Credits	2.5%	Philanthropic Trust

In the above model, traditional agricultural outputs account for 50% of the total output. Areas of plantation, in combination with rehabilitated land, provide additional benefits through wood products, carbon credits, salinity mitigation, water filtration and biodiversity. It is interesting to note that only one of the proposed clients is public sector – the cost sharing arrangement for salinity mitigation.

These benefits are sold to different clients in a mature market place that has defined and quantified the flows of valued services from the farm. The commercial viability of a agroforestry operation is therefore increased.

The capacity to bundle ecosystem services and commodities provides a product for buyers that would not be interested in dealing with many individual landholders or who are unable to meet the full costs of an on-ground project.

It is noted that, even in the absence of markets, the process of quantifying the environmental benefits associated with competing on-ground works has the potential to provide discipline into regional planning and thereby facilitation the targeting of scarce public funds. Fragmented approaches to existing government funding have lead to small incentives for specific outcomes which are often not integrated with farm management objectives. The result is small incentives and small scale projects. Those regions that have pooled funding from different environmental programs are enjoying the capacity to offer more attractive and targeted packages to landholders (Coorong, 1997).

In summary, the challenge is to develop investment structures that acknowledge and reward the multiple benefits of trees in the landscape and pool scarce capital funds through investment structure of the kind discussed in section 4.1.3.

4.2.4 Clarifying and Separating Property Rights for Environmental Services

The way in which property rights to land are currently defined is inadequate to be able to provide security for long term investments in on-ground works for multiple environmental benefits. For example, if a landholder sells carbon and water entitlements to different buyers - how are the buyers to secure their investment over a given timeframe.

One option is to create common law contracts for the provision of environmental services of a fixed period of time. As long as the outcomes and actions to be taken by the landholder can be clearly described, this is a relatively simple process.

However if environmental outcomes are to be secured in perpetuity then a change to land title that allows separation of ownership of environmental services from land is required, as is the case in forestry where the ownership of trees/timber and land can be separated. Further separations could be permitted to allow for the establishment of separate markets for environmental services such as carbon, biodiversity and water purification. It is noted that a statutory conservation covenant may be

one mechanism for achieving this outcome, although this instrument is generally restricted to achieving conservation outcomes.[5] Further, the use of statutory covenants is both administratively costly and time consuming. New South Wales is the first Australian State to pass legislation that allows for the separation of carbon rights from land.

Another critical issue is to ensure that payments for environmental services are balanced against landholders responsibilities or "Duty of Care" for sustainable natural resource management (Binning and Young, 1997). Regulations, codes of practice, environmental management systems and accreditation/certification all have important roles to play in the policy mix.

Finally, the setting of regulatory caps (as discussed in Section 4.1.1) is also a key property rights issue.

4.2.5 Quality Assurance, Monitoring and Risk Management

To have ecosystem markets there needs to be systems in place that ensure the maintenance and enhancement of ecological value. In other words, increasing the stocks and value of natural capital (Hawker et al, 1999).

Irrespective of the mechanism used to secure property rights for environmental services, those services will only be secure if there are effective ongoing quality assurance, monitoring and enforcement regimes. A range of quality assurance processes would ideally support the buyer-investment-seller framework put forward in this report: These could include:

- access to project sites (extension officers);
- assessment of project success;
- assessment of project quality over time;
- enforcement of trading rules; and
- defining rules for exiting.

Beil (2000) notes the importance of having quality assurance processes in place to certify and accredit carbon sink projects including agroforestry. One option would to require fully independent accreditation processes, such as those used by the Tasmanian Forest Practices Board to accredit Timber Harvesting plans (PLUC, 1996). Another would allow for self regulation with spot checking. The choice of certification system will clearly depend on the level of investment and resources available.

Of particular interest is the relationship between markets for ecological services and the role of environmental accreditation/certification. Both processes work through different mechanisms to reward or provide incentive for landholders to improve land management and/or environmental performance. Motivations for environmental accreditation include achieving self-regulation or internalising environmental costs by securing a marketing advantage and achieving a premium on the sale of consumer goods. On the other hand ecosystem markets seek to create new commodities and hence achieve greater financial returns through the sale of multiple products.

Certification schemes may lack the ability to measure ecosystem services, and hence setting up an enterprise to be involved in a market for environmental services may require certification schemes to be adapted. Conversely, environmental certification and best practice management systems that do account for environmental benefits are potentially a critical element in the process of creating markets for environmental services. They could fulfil the roles of quality assurance and product verification. Hence an important challenge is to identify credible environmental certification schemes and to build their capacity to measure ecological benefits.

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[5] Statutory conservation covenants are now available in all States although their application to leasehold land remains problematic (Binning and Feilman, 2000).

An ideal approach would be to view environmental accreditation as a necessary step in the quality assurance process. For example a farm's environmental management may require accreditation prior to being allowed to participate in ecosystem service markets. This would address the issue of a landholder being rewarded for actions on one part of their property whilst continuing to degrade other parts.

A related issue is determining who should bear the risk for losses due to unforseen circumstances, such as fire and other natural hazards in the case of agroforestry. One option is to establish buffers, so that the risk is shared amongst all projects (or landholders). Another option is to assign responsibility to the broker or reinsurance agency. A third option is to assign the responsibility to individual landholders.

The design of effective quality assurance processes is both challenging and complex. The view taken in this report is there is need for pragmatic experimentation with monitoring and quality assurance processes to be developed as markets mature. In the initial stages of development, some strategic risk taking is likely to be required. We return to this issue in Section 4.3.

4.2.6 Removing Impediments to Non-Government investment

Currently, non-government organisations are limited in their capacity to promote and secure land use change through markets for environmental services. This is because there are often significant impediments to the non-government sector investing in natural resource management and conservation outcomes. Issues include: taxation arrangements, trade and commercialisation of wild species, the inability to negotiate binding conservation agreements at arms length from government, poor access to finance and the near monopoly position of governments as custodian and providers of environmental data.

A number of reports have highlighted the need to increase the access of private companies and non-government organisations to providing a range of environmental services (see Industry Commission, 2001 and Binning and Feilman, 2000).

4.3 Transition – from rhetoric to reality

The previous section outlined some key issues involved in creating markets for environmental services. A final challenge is how to develop the frameworks required to begin the process of market creation. Markets of the kind described in this chapter of the report will take time to develop.

It is perhaps easier to imagine a fully mature market for environmental services backed by government regulations and clearly defined property rights, as in the case of water access markets. It is also possible to look to other agricultural commodities to learn relevant lessons. Wool, for example, has a complex network of brokers and dealers, auction based and other direct marketing systems (see for example http://wool.elders.com.au/sell_alt.aspl). In addition, comprehensive testing and quality assurance processes are in place to manage the heterogeneous nature of the commodity. These systems can cost up to 10% of value of the commodity at sale. Market infrastructure is expensive. These costs can be sustained in a large and mature market.[6]

When considering emerging markets, such as those proposed for environmental services, a more relevant question may be: what is the minimum set of policies, procedures and other institutions that need to be put in place prior to establishing a new market.

Earlier the risks governments face in market creation were discussed highlighting the potential legal and political liability if they fail. Because of these constraints it is useful to consider if markets for environmental services and commodities could be created at arms length from government. One potential model for the growth and transition into markets for environmental services and commodities at a regional is described briefly below.

> **Step 1 – Accounting:** Methods for accounting for and calculating ecosystem service credits require a system for evaluating the costs and benefits of land uses and management actions on the ground. These rules must be relatively simple but also generally applicable (Section 4.2.1).
>
> **Step 2 – Investment vehicle:** This could be best achieved by establishing a "Catchment Ecosystem Services Investment Centre". Such an agency would be responsible for assigning credits for on-ground projects within a catchment and for attracting clients or private brokers for those credits within a catchment. The success of Step 1 makes the creation of a Catchment Ecosystem Services Investment Centre much less complicated than it may seem. Options could range from developing a simple investment portfolio based on a natural resource management strategy to the potential to introduce e-commerce as a link between urban populations and regional Australia (Section 4.1.3).
>
> **Step 3 – Marketing and Finding Clients for the Credits:** The Catchment Ecosystem Services Investment Centre would initially act as an accounting and marketing device. The Centre would be able to quantify the benefits derived from investment and make these transparent for investors. The Centre would be able to pool relatively small benefits for new buyers (Section 4.1.1).
>
> **Step 4 – Allocation of Credits:** A key task for the Investment Centre is how to allocate credits for on-ground projects. Two principles would guide this process: Credits would be allocated for (1) all benefits derived from a project; and (2) in proportion to the contribution of funding partners (buyers) including landholders.

[6] It is noted, however, that even in the case of bulk commodities there are continuing pressures to minimise transaction costs.

Step 5 – Facilitating Trading of Ecosystem Services Credits: Credits could be bought or sold for any price the market demands. Rationale for trading prior to the introduction of regulatory caps could include:

i. To speculate on their future value;

ii. To retire them to secure permanent land-use change in the region for philanthropic or other reasons; or

iii. To offset debts accrued from works expected to occur after the introduction of regulatory caps (Step 6).

Step 6 – Setting a Regulatory Cap and Establishing Offsets Programs: The Catchment Ecosystem Services Investment Centre, in conjunction with State government, may seek to establish caps on resource use and establish offset arrangements for some of the ecosystem services in a catchment. The principle here is that developments that have environmental impacts must offset their impacts elsewhere within the region through the purchase and trading of credits.

Step 7 – Monitoring and Adapting the System: ensuring that the ecosystem services credits and trading programs can be adapted over time as knowledge increases and circumstances change.

The steps outlined here represent only one regional approach to transition from government grants and incentives programs to markets for environmental services. Others can be envisaged and it is unlikely that one model will suit all situations. The challenge for government is, once again, to create an environment for experimentation and policy learning.

An experimental approach, of the kind advocated here requires that particular attention be paid to putting in place processes for monitoring and adapting the system through time. Indeed a key principle in the design of all policy intervention is to define how rules, entitlements and obligations of the various players/agents will be adapted in the future (Young et.al, 1996).

5 CASE STUDIES OF ECOSYSTEM MARKETS

5.1 Australian examples

Even though no formal trading framework is in place, a number of Australian firms and government agencies have begun to explore opportunities to invest in ecosystem services, particularly carbon sequestration through planting trees. Following from international developments, several Australian firms have begun to offer greenhouse gas brokering services. Emission Traders Pty Ltd and CO_2 Forest Sinks Pty Ltd, for example, are offering to arrange for the acquisition of rights to any greenhouse gas credits associated with investment in timber plantations. Other companies are negotiating directly with large plantation owners such as State Forests NSW. Firms are taking opportunities to secure market advantage and promote their concern for the environment.

Markets for biodiversity have generally stemmed from revolving funds and sale of bushland blocks. A revolving fund involves the purchase of land by a conservation trust, placing a binding conservation covenant to protect the biodiversity values of the land on the land title, and then reselling the land to a willing landholder. This process aims to maintain a capital fund by re-marketing a parcel of land as a conservation property. Philanthropic conservation organisations, such as Trust for Nature (Vic) have led this development, however market-based mechanisms that would integrate with agroforestry or other production systems are yet to be implemented.

5.1.1 Innovative forest products (State Forests of NSW)

NSW State Forests are advancing rapidly towards producing products for ecosystem markets. Such products include carbon for emissions trading or to use against emissions, biodiversity credits and nutrient recycling credits. Dr Bob Smith, CEO of State Forests of NSW, has suggested that globalisation is creating more competition and reducing the price of commodities, meaning that competitive advantage will result from product differentiation and value adding (Smith 2000).

Environmental Stewardship is becoming a key commercial driver of forests. Smith sees the future major commercial force for State Forests in the management of forests for climate change, water quality and biodiversity.

Increasingly business success in all sectors is linked to environmental credentials that link in with the Kyoto Protocol and other environmental conventions, which are moving towards targets. Certification and ‘environmental branding’ is the current and potentially future market advantage for gaining and retaining consumers.

The possibility of carbon trading is opening up new opportunities for investment in forests. One example is the Tokyo Electric Power Company (TEPCO) investment in NSW State Forests. State Forests have executed an agreement with TEPCO who will invest in between 10,000 and 40,000 hectares of new planted forests over the next decade. State Forests advise that TEPCO's investment will potentially generate over 1 million tonnes of carbon dioxide absorption per annum during the Kyoto commitment period 2008-2012 (NSW Treasury 2000).

This and similar one-off trades, have given rise to difficulties in creating a carbon sequestration credit, including:

- How to trade a credit?
- Insurance of certificate
- Accreditation and registration
- Vertification of carbon accounts
- Land titles (carbon sequestration rights, forestry rights, land ownership)

To ensure the benefits flow to rural communities, State Forests has developed annuity payment and joint venture mechanisms to reduce risk to landowners. There is still a need to link payments for environmental service with ongoing product markets, for example ensuring that agroforestry projects have access to carbon, bio-fuel, and biodiversity markets as well as timber products.

State Forests are involved in a number of other trials of markets for environmental services including: the marketing of plantation thinnings for firewood (to replace woodland clearing), marketing of biodiversity projects to potential private investors, and woody weed control as a source of bio-fuels. Their approach is one of market exploration.

5.1.2 Carbon trading

Under the Kyoto Protocol to the United Nations Framework Convention On Climate Change of December 1997, "Annex B" countries (which includes Australia) agreed to assigned amounts of "aggregate anthropogenic carbon dioxide equivalent emissions of greenhouse gases" over the period 2008 to 2012. This means that Australia is committed to emissions of 108% of the 1990 level of carbon dioxide equivalents (CO_2-e) by 2008 to 2012.[7]

An emissions trading system, if introduced, would be based on a permit that authorised the holder to emit a specified amount of greenhouse gas. The advantages of an emissions trading system over other approaches are, its potential to minimise the costs of achieving a given level of greenhouse gas abatement, and its certainty in meeting an emission target.

Carbon sinks, such as forestry plantations, could be incorporated into a national emissions trading system by issuing a 'carbon credit' for each tonne of CO_2-e sequestered in a Kyoto Protocol forest or plantation. Such credits would be tradeable instruments, and could be used interchangeably with emission permits in any emissions trading system.

Only carbon sequestered in the Kyoto Protocol commitment period (2008 to 2012) would be included in an international emissions trading system. Carbon sequestered before 2008 would only have value in Australia emissions markets. There would be no limit to the supply of carbon credits Australia is able to issue under the Kyoto Protocol - provided the credits were for eligible Kyoto Protocol forest sequestration occurring during the commitment period, 2008 to 2012. These credits would therefore be additional to Australia's emission commitment. Australia is currently the market leader in the development of ecosystem markets and carbon credits (Hosking, 2000).

Potential investors need to view the carbon credit system in its entirety. There would be potential financial benefits but also a liability if the land were subsequently deforested. The responsibility for acquittal would need to reside with the entity that takes the economic decision to harvest the trees.

For commercial forestry, there would be the opportunity to generate income while the trees were growing. There could also be the potential for a relative cost advantage for timber over substitute materials, where production of such materials involves greenhouse gas emissions.

Integration of the national trading system with international trading requirements and conventions under the Kyoto Protocol will be a key requirement. The system will need to recognise the emission credits generated as a result of abatement activities undertaken through the Clean Development Mechanism and Joint Implementation, in addition to those associated with sequestration. The ability to substitute these instruments for nationally traded permits and, ultimately, Assigned Amount Units is fundamental to the trading and acquittal regime established under the Kyoto Protocol.

[7] There is of course considerable uncertainty surrounding the implementation of Kyoto Protocol with negotions continuing the Conference of Parties to the Climate Change Convention (COP 6) meeting to determine next steps.

5.1.3 Auction systems (Victorian Department of Natural Resources and Environment)

The report 'The role for auctions in tradeable emission markets' (Stoneham and Chaudhri 2000) outlines three policy mechanisms that could be employed to manage environmental problems that stem from land use advocates the use of 'auction of land-use change' as a mechanism for including non-point source emitters into tradeable permit markets where these markets intersect with land use.

Auctions specifically accommodate the problem of variable environmental benefits. Added to this, it is argued that auctions have low transaction costs, require minimal government interference, and are transparent with clear specification of partial property rights over resources.

Auction systems are to be trialled in Australia in 2001 in both Victoria (NE Region) and the Liverpool Plains in NSW.

5.1.4 Vegetation Bank – Murray Darling Basin Commission

The Murray Darling Basin Commission has proposed that governments establish a "vegetation bank" into which they contribute funds for targeted investment in reafforestation and vegetation management. The vegetation bank would supplement commercial return to plantings where there are measurable environmental benefits. Consistent with the Integrated Catchment Management Policy Statement of the Commission funds would only be invested where there were are measurable environmental benefits. The vegetation bank would compete with commercial forestry in high rainfall regions (MDBC, 2001)

5.1.5 Biodiversity trade-offs

Shields (2000) proposes the establishment of a system of direct payment for maintenance, enhancement or restoration of biodiversity values. Individuals, corporations or governments who manage land or resources available for development in a manner that maintains, enhances or restores biodiversity values from a degraded state, are eligible for direct payment of financial capital.

Payment is made by individuals, corporations or governments that are responsible for developments. Such payments are dependent upon the depletion of biodiversity values. Payment is commensurate with the loss from the world's ecosystem as a result of these activities. In return for payment, the buyer gets recognition for biodiversity-friendly development. Most importantly, a buyer who pays for biodiversity credits is permitted to undertake an enterprise without further regulatory constraints.

Methods of benchmarking biodiversity are currently being improved (Shields 2000; Brand 2000; Briggs pers. comm.).

Trading biodiversity against development generates considerable moral questions. Therefore it is important that the initial evaluation of what a credit is and what a credit is worth is scientifically and socially sound.

5.1.6 Salinity schemes

The Hunter River Salinity Scheme (NSW EPA), which licenses saline discharges from coal mines and Pacific Power, replaced a regulatory system that limited the increase in salinity from individual discharges, with the current pilot scheme, which is a cap and trade mechanism. It is about to be extended and formalised into a fully fledged scheme through legislation (NSW Treasury 2000).

Under the scheme, the allowable load of salt varies with stream flow levels. Each licensed participant receives salinity credits, which are expressed as a percentage of the total allowable salt load. Credit limits are calculated for individual blocks of the river. The EPA retains credits as an environmental buffer. Credits can be augmented by purchase of dilution flow releases from upstream storage. Credits can be traded subject to an overall "consent condition" exercised by the EPA. Trades must be registered and participants bear upstream and downstream monitoring costs.

A similar approach involves the Murray Darling Basin Salinity and Drainage Strategy, which provides for a high level tradeable credit scheme whereby salinity credits can be earned by the participating States through salinity diversion works (MDBC 2000). These can be used to offset salinity debits incurred through discharges against individual State caps. Credits earned in this way are expected to be largely used to offset debits, therefore trading would be correspondingly thin.

Under a Memorandum of Understanding with State Forests of NSW, Macquarie River Food & Fibre (MRFF) has agreed to purchase the first salinity control credits generated by new forests planted in the salt prone Macquarie River catchment in the central west of New South Wales (Treasury, 2000).

MRFF, which represents more than 600 Macquarie Valley irrigation farmers, will purchase salinity control credits based on the quantity of water transpired from 100 hectares of newly planted forest in the upper Macquarie catchment. The irrigators will benefit from the investment in upper catchment tree plantings by securing water quality downstream, with flow on benefits to the rest of the water-using community in the Macquarie Valley. Those trees planted in the upper Macquarie catchment will help reverse the problem of rising water tables which lead to dryland and stream salinity in the valley with a very long delay. The motivation for such action is primarily publicity.

5.2 International examples

At the global scale, past economic thinking usually considered that ecosystem services had little or no economic significance (Edwards and Abivardi 1998). However, the emerging discipline of ecological economics, and its integration into mainstream economics, has identified the need to promote market development for ecosystem services and commodities (Current et al. 1995). To date, there has been a lack of market incentive for ecosystem products, particularly in the agroforestry sector (Rodrigues et al. 1998).

While emissions trading has been practised around the world, it was not until the Kyoto Protocol that it really became an international issue. Now the race is on to define what a carbon credit is and how it is to be marketed and regulated. However, carbon is not the only emission credit now under consideration; salt, biodiversity and water quality are also under consideration globally. Emissions trading, whether domestic or international, is a scheme whereby entities such as companies are allocated allowances for their emissions. Companies that reduce their emissions by more than their allocated allowance can sell their “surplus” to others who are not able to reach their target so easily. This trading does not undermine the environmental objective, since the overall amount of allowances is fixed. Rather, it enables cost-effective implementation of the overall target and provides incentives to invest in environmentally sound technologies (European Commission 2000).

The International Emissions Trading Scheme starts in 2008 (European Commission 2000). The European Community (EU) and member states are planning to prepare themselves by commencing an emission trading scheme within the EU by 2005 (European Commission 2000).

In the United States of America, emissions trading of sulphur dioxide, under the 1990 Clean Air Act, has been very successful. It has been estimated that the tradeable permits approach to sulphur dioxide control has reduced the costs of achieving specified air quality targets set by the EPA by $225-$375 million. Other tradable permit programs in the US include ammonia, phosphorus, arsenic, cadmium, copper, lead, nitrogen and wetland mitigation (Stoneham, 2000). Here in Australia the Sydney Futures Exchange has already started to trade in Carbon Credits.

5.2.1 Tradeable permit schemes (United States)

Tradeable permit schemes provide perhaps the best examples of the use of market based instruments. Standard tradable permit schemes allow participants to trade their allowance or credit of a particular pollutant. The primary examples of tradable permit schemes relating to air pollution come from the United States and generally involve application of a cap and trade approach (NSW Treasury 2000).

Sulphur Dioxide Emissions trading in the US is an example of a cap-based mechanism. This program operates under the 1990 Clean Air Act in the US and is administered by the EPA. It has been estimated that the tradable permits approach to sulphur dioxide control has reduced costs of achieving specified air quality targets set by the EPA by $225-$375 million. Key factors in the success of the sulphur dioxide scheme include: low transaction costs, stationary emitters, speculation, easy access to trading mechanism, minimal government interferences, transparency and clear specification of partial property rights over resources (Stonneborn 2000).

The success of tradable permit schemes in the US can be attributed to:

- Few constraints on trading among participants,
- Clear allocation methods and simple rules for trading,
- Trading operates within tightened command-and-control regulations, and
- Support from the wider community (eg, ozone-depleting chemicals).
- Transaction costs remain the most limiting factor for success of such schemes.

It is important to remember that the market size in the US, with a population of about 270 million people, is much larger than Australia.

5.2.2 Wetland banking (United States)

Wetland banking has been in place in the USA since the mid-1970s. It allows for developments that affect wetlands to be offset against works that rehabilitate wetlands offsite. By 1992 in excess of 40 banks were operating in the USA that had facilitated the rehabilitation of about 20 000 acres of wetland. There are now several hundred wetland banks in operation throughout the United States (Environment Law Institute 1993).

In recent times the concept of mitigation banking has been extended to the protection of habitat for species listed under the USA's Endangered Species Act.

Wetland mitigation involves protection, restoration, creation and/or enhancement of wetlands for the purpose of compensating for unavoidable loss of wetlands in advance of development actions when such compensation cannot be achieved at the development site or would not be as environmentally beneficial.

A wetland bank is created when a sponsoring organisation undertakes a major restoration task. Once the restoration project is completed credits are provided for the value of the work undertaken. Different credit rates can be given for creation, restoration, or protection of wetlands. These credits can then be used to offset adverse impacts on other wetland areas caused by development. New developments that affect wetlands must buy credits to satisfy a prescribed impact rate. Hence a combination of the credit and impact rate determines the ratio between the area restored and the area affected by development. A committee, constituted of representatives from relevant regulatory authorities, generally sets both credit and impact rates on a project by project basis. Net rates can vary widely from 1:2 (ie development of one hectare of wetland requires an offset of 2 hectares of remediation work offsite) to as high as 1:20 (Environment Law Institute 1993).

Key features of wetland banking include:

- Wetland banking has no impact on regulatory approval processes for environmental projects;
- Mitigation works have to be completed prior to credits being drawn upon; and
- Large scale and strategically targeted conservation works can be undertaken that provide much greater environmental benefits per dollar invested than small scale on-site remediation activities.

Wetland banking has facilitated large scale rehabilitation works that would otherwise not have been possible. The process has proven highly profitable for a number of environment rehabilitation

companies who are able to on-sell to developers seeking to off-set impacts prior to development being approved. Benefits have also been provided to developers who now have greater certainty and a mechanism for offsetting adverse impacts.

In trying to find innovative solutions to problems associated with standard onsite mitigation compensation, wetland mitigation banking became an important component of the Clinton Administration's Wetland Plan, introduced in August 1993.

Experience has shown, however, that the policy in fact did not lead to no net loss but to a reduced rate of loss (Torok et al. 1996, Race and Fonseca 1996, Kentula et al. 1992), so its' current application now requires the creation or enhancement of a larger area of wetland than will be lost, the multiple depending on the conservation status of the wetland type (Brinson and Rheinhardt 1996). Losses continued despite mitigation works because:

- some promised mitigation projects were never undertaken;
- many mitigation projects did not reach their performance goals; and
- some mitigation projects failed completely.

The application of this type of model to a catchment or region in Australia would be extremely challenging. Rules for assigning credits for conservation works would need to be developed. Likewise rules for assessing impact of approved developments would also have to be calculated.

5.2.3 Sustainable farm forestry (Central America)

Kishor and Constantino (1994) note that a sustainable farm forestry operation is not a profitable investment under the typical incentives structure. The challenge for implementing farm forestry in the future is to develop institutional mechanisms that will make developed country buyers and tropical country sellers willing to enter into market transactions for the global environmental services provided through sustainable farm forestry in Central America.

The strength of this program lies in linking potential funders (populations in developed countries) to benefits gained from global ecosystem services in developing countries. Unfortunately there are few institutional options relevant for developing countries being explored.

5.2.4 The Costa Rican protected areas project

Stuart (1997) describes two parallel carbon sequestration programs in Costa Rica. Profits from a gasoline tax are used for national park management and to provide knowledge and incentives to private landholders for the uptake of sustainable management practices. In combination, this effort provides an increase in carbon sequestered through vegetative regrowth and the sustainable use of land. The Costa Rica Office of Joint Implementation then pools those sequestration benefits, and on-sells them as a "certified trading offset" (CTO) to international emitting firms. The revenue is re-invested into the system creating a revolving fund. This process has sequestered over 1 million tonnes of carbon for "risk free" trade as CTOs, with around 700,000 tonnes retained in a buffer to cover for uncertainty and risk.

6 KEY ISSUES – A RESEARCH AGENDA

This paper has highlighted the potential role of agroforestry in addressing a number of pressing environmental issues in Australia. In doing so it has highlighted a number of key research issues that require further development over the coming years. These are briefly summarised below.

Coordination of existing programs

Our analysis of existing policy tools revealed that agroforestry often falls between the gaps of government programs directed at commercial forestry and those directed towards environmental outcomes. Because agroforestry operations generally have a commercial focus they will often not qualify for government assistance.

Agroforestry is an activity that requires the integration of different government programs and a more mature approach to the combined commercial and environmental benefits of trees on farms. At a practical level this will mean coordination of existing extension services to ensure landholders are aware of the full range of options and the development of cost-sharing arrangement that are able to create synergies between government programs that may impact on agroforestry.

Accounting for and crediting ecosystem commodities

Many of the environmental values of agroforestry are currently unaccounted for. There is an urgent need to develop accounting standards for ecosystem services as is currently being done in relation to carbon sequestration. Challenges in developing measures for biodiversity and salinity mitigation are highlighted in the body of the report. A second challenge relates to being able to account for different ecosystem services concurrently to make transparent the multiple benefits arising from farm forestry operations including contributions to on-farm productivity.

Disciplined regional planning

Agroforestry is needed as a key driver of landscape rehabilitation in many of Australia's regions. However, a more disciplined approach is required. Planting trees is not a universal good. Different spatial configurations and types of plantings will have very different environmental outcomes. There is an urgent need to set regional natural resource management targets and use these as the basis for setting priorities and targeting scarce resources. Using physical accounting standards it should be possible to quantify the contribution of individual projects to meeting a number of concurrent objectives. Monitoring and accountability structures for regional natural resource management also need to be tightened as proposed under the *National Action Plan for Salinity and Water Quality*.

Leveraging Public and Private Investment

Achieving greater uptake of agroforestry requires investment in currently un-marketed ecosystem services. Government does not have the resources required to make these investments alone and must look to using scarce public funding to leverage landholder and non-government sector investment. To do this an investment vehicle is required that accounts for ecosystem services and pools them in a manner that will be attractive to investors. Governments have a key role in facilitating the development of investment vehicles and providing catalytic funding.

A particular challenge is engaging urban Australians in regional environmental outcomes. This market is largely untested and thus involves risk. Ultimately government regulations that cap resource use and create scarcity will be required.

Designing the Investment Vehicle

The design of investment vehicles that are able to link potential buyers (public or private) of environmental services with on-ground projects that deliver environmental benefits is a emerging issue which is currently attracting significant attention from policy makers.

Desirable attributes for an investment vehicle include:

- Rights of receiving or selling ecosystem units or "credits" are fully specified, including a definition of a credit, entitlements and obligations;
- Trading arrangements are rule-based with a periodic review mechanism that does not compromise investment or financial security;
- Administration, monitoring and enforcement costs are as low as possible; and
- Transaction costs for investors, brokers, dealers and landowners are low.

A number of models can be envisaged with different distributions of risk and security between buyers, brokers and sellers associated with them. Because of the entrepreneurial nature of market creation a high degree of learning, experimentation and innovation would be a critical output from an initial set of pilot investment vehicles before regulatory backing is considered to formalise a buyer-investment-seller framework

Coordination of markets for environmental services with environmental management systems and environmental certification

We have noted a potential tension between the role of environmental accreditation and markets for environmental services. Motivations for environmental accreditation include achieving self-regulation or internalising environmental costs by securing a marketing advantage and achieving a premium on the sale of consumer goods. On the other hand ecosystem markets seek to create new commodities and hence achieve greater financial returns through the sale of multiple products.

Certification schemes may lack the ability to measure ecosystem services, and hence setting up an enterprise to be involved in a market for environmental services may require certification schemes to be adapted. Conversely, environmental certification and best practice management systems that do account for environmental benefits are potentially a critical element in the process of creating markets for environmental services. They could fulfil the roles of quality assurance and product verification. Hence an important challenge is to identify credible environmental certification schemes and to build their capacity to measure ecological benefits.

Caps and regulations

Im mature markets for environmental services are to emerge governments will need to regulate the use of key ecosystem services. Key issues for agroforestry relate to the regulation of clearing of native vegetation and possible introduction of rules for "no net loss" of vegetation. The introduction of caps requires innovative rules that balance complex trade-offs between different types of developments. The design and implementation of flexible and adaptable trading regimes for key ecosystem resources is a key issue.

Transition – Moving from rhetoric to reality

Markets for environmental services seem a long way off. Yet the Commonwealth government is actively assessing the potential use of market mechanisms in the development of the new National Action Plan for Salinity and Water Quality. Likewise the Victorian government is experimenting with the use of auction systems. NSW State Forests and the Department of Land and Water Conservation are experimenting with different projects and proposals.

How do we move from rhetoric to reality? How should risk be shared? How do we attract new investment? These are all key questions. The process of establishing ecosystem accounting standards

and undertaking more disciplined regional planning is a necessary starting point. The issue is whether this process can be married with one of market creation.

What is needed is a period of active and participatory research. The process of setting targets and learning to account for on-ground actions against those targets is necessary irrespective of the policy instrument chosen to deliver incentives for agro-forestry. Working with a number of regions key questions could be answered including: how to use existing regional plans and data to more effectively target programs, how to pool resources from different programs and how to test the willingness of the non-government sector to invest.

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APPENDIX 1: PROCEEDINGS OF WORKSHOP

Meeting Attendance List:

Name	Organisation	Contact
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Seona Meharg	CWE	s.meharg@dwe.csiro.au

This meeting was arranged to firstly guide the development of our report on markets and incentives for agroforestry and secondly, to provide an opportunity for individuals with an interest in this area to meet, discuss ideas and build collaborations.

Presentations

Jason Alexandra – National Strategy for Ecologically Sustainable Development

The goal is:

- Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

The guiding principles are:

- Decision making processes should effectively integrate both long and short term economic, environmental, social and equity considerations.
- Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- The global dimension of environmental impacts of actions and policies should be recognized and considered.
- The need to develop a strong, growing and diversified economy, which can enhance the capacity for environmental protection, should be recognized.
- The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognized.
- Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms.
- Decisions and sections should provide for broad community involvement on issues which affect them.

Reference: Commonwealth of Australia (1992). National Strategy For Ecologically Sustainable Development, December 1992. Canberra AGPS.

Roslyn Prinsley - Joint Venture Agroforestry Program (JVAP)

JVAP Guiding Objective

- To integrate sustainable and productive agroforestry within Australian farming systems
- JVAP have done a lot of work on incentives in high rainfall zones. Now the focus is on low rainfall zones and looking what incentives would get farmers to plant trees on their land.

JVAP addresses why, where, what and how trees should be planted in the landscape. JVAP has recently developed guidelines for design of agroforestry, entitled "Trees, Water and Salt", to address salinity, which would be useful for quantifying salinity benefits.

Andrew Campbell - LWRRDC Strategic R&D Plan 2001-2006

Vision is to get Australians to celebrate our unique and diverse landscapes and manage them for all their values.

LWRRDC's Proposed Mission:

To provide national leadership in generating knowledge, informing debate and inspiring innovation and action for sustainable natural resource management.

Heather Tomlinson – AFFA

- There is a lack of understanding about economic incentives for agroforestry
- We need to change market behaviour first before we define incentives
- Firstly we need to look at as many market based incentives as possible and then re-educating the market.
- Need to identify water and it's linkages between services for above and below ground water, such as for ecosystem services and salt
- Need to know how to bring markets together
- How do point source drainage schemes fit in the model?
- We need to try to define a national policy for a long term solution, by desiging policy frameworks. ie what can we get governments to commit to?

John Powell - Strategy for Salinity Management report within the Murray-Darling Basin.

Key objectives to meet and evaluate targets out to 2015, and water quality/quantity targets

- To maintain the water quality of the shared water resources of the Murray and Darling Rivers
- To control the rise in salt loads in all tributary rivers and, through that control, protect their water resources and aquatic ecosystems at agreed levels
- To control land degradation and protect important terrestrial ecosystems, productive farm land, cultural heritage, and built infrastructure at agreed levels
- To maximise net benefits

Mike Young – CSIRO Land & Water

The emissions trading system needs continuous work, we need to have economic instruments along with other community based incentives. Added to this there needs to be a government policy on caps, credits and emissions trading. There is a need to go through legislation and change what is needed.

How do we find these mechanisms and vehicles that transfer funds from other industries to agriculture? There are many ways for changing people's behaviour, we would need to research which are the most effective. There also need to be a framework for how to effectively spend large dollars across landscapes at a large scale.

Working just for water can backfire, creating other environmental and social problems. The appropriate opportunities need to be communicated simply, with a simple design system for trading.

We need to set up markets for trading and discover how we could simulate these markets. Maybe we could set up a system of trading between water and salt, using computer games to see what flaws there are in the system.

Sue Salvin - Carbon, Environmental Services and Planted Forests in NSW

Strong corporate strategy has changed from production of timber to being an environmental service provider which supplies forest products. 20% of State Forest revenue will come from new markets. So far State Forests have dipped toe in the water of the emissions trading market (exchange of rights). The question of whether State Forests have the right to trade in rights and do we need to change legislation. ie define what the rights are, such as the owner of land, the owner of the timber and the owner of carbon. How to separate the rights?

Currently State Forests are the broker, manager and reviewer of the carbon trading, however the timber revenue is needed to back up carbon rights until the Kyoto Protocol is signed. The landholder can rent land to State Forests, where State Forests has all the risk. Some are branching out and taking the risk on their own. Need to research other products and incentives in low rainfall areas to make it work, such as biomass fuels, charcoal.

Charlotte Duke – Victorian Department of Natural Resources and Environment

There are problems with public goods, such as market failure. The public have better knowledge of how much it costs them to reduce their pollution output than we do.

Markets are not the only answer, more than one policy is needed. Legislation is good for stopping things right now, whereas markets are more long term. For markets to succeed the needs to be Safe minimum standards (CAP), which creates the scarcity. Taxation is good for point source emitters, with similar marginal costs. Non-point source people are not yet caught up in current taxations.

Tradable emission permits for non-point source emitters need to have a solid contract to work, which would:

- Gives right to exploit for economic growth
- Set out Grandfathering or auctioning (tradable permits with auctions, therefore drop price of permits – increase environmental benefits)
- Define rules of trade, experimental economics and game theory will help in this situation

Louise Rose and Lalage Cherry – AGO

Bush for Greenhouse started in 1997, it builds on EA's bushcare and the greenhouse challenge program. It is a pilot program about how to use carbon with revegetation. The aim is to use private investment to put carbon back in the landscape and bush back in the ground.

Sue Briggs (NSW NPWS) – Benchmarking Biodiversity Credits in Collaboration with SF, CWE

Aims of the Project

- To provide the means of assessing the biodiversity value of a block of land (or water),ie, of an ecological community, against a benchmark community
- Benchmark communities are those in a desirable state, against which the biodiversity value of other communities ("natural, planted) can be assessed
- Three community types will be benchmarked initially (depending on $$)
- Assessment of the biodiversity value (no. of biodiversity units) of a community against the benchmark community will be undertaken using several variables (measures of desirable state) Need different values for different processes (biodiversity values).
- Biodiversity credits (or units) will be assigned to a community (block of land) according to its relative value assessed against the benchmark community.

List of Important Issues:

- Transition (Integration with existing institutions and regions)
- Bundling and Cross compliance (bundling of rights)
- Bundle markets (how do we work through the issue, who goes first)
- Instrument selection, what is an investment framework (vehicle), how would it work.
- Biodiversity definition
- Baseline for ecosystem services
- Definition and counting, linking cause and effect
- Empower regions and integrate with regional planning and capacity
- Moving beyond what people were going to do anyway
- Links between planting trees and water supply (agroforestry is water stealing)
- Property rights
- Enforcement of all of these contracts, security in abstract markets / trust
- Managed crisis situations (don't go softly)
- Getting to caps => objectives => targets => to caps
- Provide to catchments a clear guide to incentive selection, (finding policy driver)
- Lack of understanding in ecosystem services (we need to know more)
- Not just planting trees => the whole forest estate
- Institution Integration / Failure – culture and awareness. Attitude to farm forestry, some people do not like the look of trees, worried about State forests taking over.
- Got to have a model that goes from the national scale to the farm scale (getting dollars from National to local)
- Roles and Responsibilities
- Experimenting / finding / earlier adopter / risk taking / learning
- Price discovery
- Targeting actual on ground priorities, targeting landholders
- Rights v's responsibilities
- Corporate finance
- Incentives v's markets
- Information support for catchment communities to choose between agroforestry and/or other instruments such as grassland/shrubland.
- Benchmark (status) of environmental resources
- Commercial markets may be sufficient in many areas
- Watch out for crowding out of the government. How do we focus attention on Policy Objectives?
- In some places there is no need for our environmental services markets
- Targets/limits/caps => energy efficiency as a target

APPENDIX 2: TECHNICAL NOTE

Engaging landholders in delivering ecosystem services

How are landholders engaged in projects to supply ecosystem services? Section 4 noted that landholders have a range of motivations for investing in agroforestry ranging from commercial to intangible benefits. A key challenge in the creation of markets is to reveal those landholders with the highest willingness to undertake agroforestry. A second challenge requires that consideration be given to the ecosystem benefits of different plantings to encourage investment in plantings that yield the highest return. Thus two primary factors need to be considered in the process of engaging landholders:

1. The willingness of the landholder to undertake agroforestry operations; and
2. The environmental benefits associated with the on-ground works

A number of other factors may be considered in the design of incentive programs for engaging landholders (Young *et al* 1996):

- **Effectiveness** (incentive for improved efficiency and environmental performance);
- **Equity** (acceptable burden of costs between resource users);
- **Acceptability** (including compatibility with existing institutions);
- **Dependability or certainty** (of environmental outcome); and
- **Precaution** (when facing irreversible losses).

The importance of these criteria vary depending on the values used in the assessment process. A person with an interest in social justice may place emphasis on equity, an ecologist on dependability and precaution and an economist on effectiveness.

There are a number of different approaches to engaging landholders and providing incentives that place varying emphasis on the different criteria outlined above. These approaches are outlined with reference to Figure 7 below, which depicts a simple upward sloping supply curve, with the area of land planted to agroforestry increasing as the net level of incentive payment increases. Hence, a general proposition for all of the approaches outlined below is that: as the size of incentive provided by buyers of ecosystem services (Demanders) increases, the quantity of agroforestry provided by landholders (Suppliers) will also increase.

Catalytic incentives

As described in Section 4, a catalytic approach to incentives seeks to work with the most willing set of landholders to demonstrate the benefits of planting trees. It does so for two reasons: first, to obtain maximum benefit for scarce funding for incentives; and second, to increase the willingness of other landholders in subsequent time periods.

In Figure 7, catalytic incentives are represented by a relatively low level of incentive payment P_0, which in the first instance yields modest uptake to deliver an increase in plantings from Q_n - Q_o. However, it is hoped that, through a demonstration effect, a shift in landholder willingness can be achieved as represented by the shift in the supply curve from S_1 to S_2 over time. In the diagram a pivotal shift in supply is shown including both a shift and an increase in price elasticity. This would mean that, in time, a further increase in the level of plantings can be achieved from $Q_0 - Q_1$ without the need for an increase in incentive payment.

A catalytic approach to incentives could perhaps best describe the rationale behind incentive payments under the Landcare and Natural Heritage Trust programs. Emphasis has been placed on education and

raising the profile of planting trees on farms with a view to increasing participation through time. As discussed in Section 4, this approach can be effective up to a point. However, if a higher level of participation is desired, say achieving Q_d, then larger incentives will be required. In the absence of a catalytic approach, however, the increase in payment required (P_2) will be larger than that required with catalytic approach (P_1) because of the shift in supply achieved.

The potential to achieve shifts in supply, that is an increase in landholder willingness, provides strong rationale for retaining a mix of education, regulation and incentive programs in the design of any incentive program.

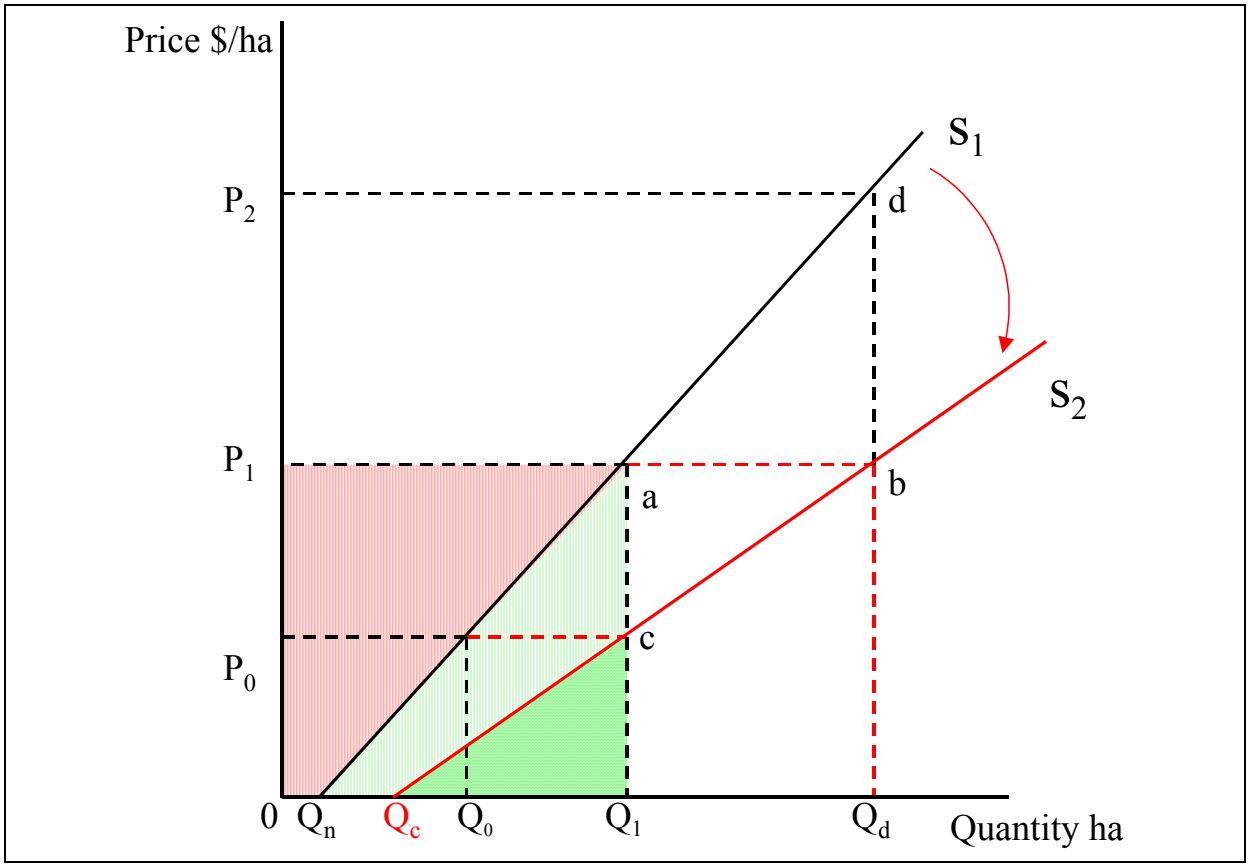

Figure 7: Supply of ecosystem plantings under different strategies for landholder engagement

Cost sharing (beneficiary pays)

Another approach to calculating incentive payments is the use of cost sharing principles as advocated by the Murray Darling Basin Commission (1996). Under this approach payments are made on the basis of the beneficiary pays principle. This means that incentive payments are made on an estimate of the public benefits associated with tree plantings. One example is the Coorong and Districts Local Action Plan (1997) where incentive payments vary from $250 per ha for plantings with only a salinity benefit to $400 per ha for plantings using local species that have a biodiversity and salinity benefit.

Under this approach incentive payments tend to be higher that those provided under a catalytic approach, say $P_0 - P_1$. This should result in a higher participation Q_1 but may not lead to as large a shift in supply as outlined under the catalytic approach, because landholders are signalled that higher incentives payments will be paid in the future.

A consequence of the cost-sharing approach is that all plantings of the same environmental benefit receive the same payment. This means that cost to revenues can be measured as the area bounded by

the points 0, P_1, a, Q_1 (shaded green and red). Such an approach is equitable but may not be as cost effective as other strategies such as auction systems.

Auction systems: extracting private rents

An auction system as proposed by Stoneham and Chaudhri (2000) seeks to extract all private rents associated with tree plantings by asking land managers to place bids on the level of incentive payment they require to invest in planting trees. In theory, each landholder will bid at the marginal value to them meaning that revenue costs can be minimised. In Figure 7, incentive payments would vary from $0 - P_1$ meaning that costs to revenue would be reduced to Q_n, a, Q_1 (the green shaded area). If a catalytic effect is experienced further savings may be generated by reducing the costs to revenue to Q_c, c, Q_1 (dark green shaded area).

Auction systems have not been used in Australia although they are soon to be trialed by the Department of Natural Resources in Victoria (Stoneham, pers.com). There are many challenges in getting landholders to reveal a true bid because there is incentive to engage in strategic behaviour. For example, guessing what the maximum payment may be and bidding at that level. Considerable work has been done through the Conservation Reserve Program in the United States to address this issue.

In the absence of education and regulatory mechanisms, a system of this kind may not create a shift in supply (landholder willingness).

Auction systems are not equitable because different payments are made to different landholders for the same type of work. In essence the government acts as a monopoly buyer and extracts all of the supplier (landholder) surplus (the red area) through the bidding process.

Where multiple buyers exist, competition may drive the price of plantings up, thereby redistributing the surplus to landholders. If markets for environmental services that allow trading are created, it is likely that this will be the outcome. However, as long as funding for incentive payments remains low, auction based systems have the potential to yield significant improvements in the cost effectiveness of incentive programs. The transaction costs associated with such an approach may, however, be high.

Equal pay for equal work

Equal pay for equal work requires that the same payment be made for the same level of work. It is similar to a cost-sharing approach with the important exception that payments do not vary with environmental benefit. An example would be a fixed incentive per ha of plantings irrespective of environmental benefit. Many existing grants programs take this approach such as fencing assistance provided at $1200 per km under the Bushcare program – although environmental benefit may be used to rank proposals for funding.

Under this approach achieving the desired level of plantings Q_d would require an incentive payment P_2 and have a high cost to revenue of 0, P_2, d, Q_d.

Discussion of different approaches for engaging landholders

The different approaches to incentive program design have different strengths and weaknesses. The relative merits of different approaches are dependent on two factors: first, the effectiveness of each approach in achieving its objective, for example shifting supply (catalytic approach) or extracting landholder rents (auction systems); and second, value judgements about the relative importance of different design criteria particularly cost effectiveness, equity and, although not discussed here, administrative cost.

The answer to the first of these factors is empirical, however we are unaware of any work in this area. What for, example, has been the effectiveness of the Landcare program in creating a catalytic effect, shifting supply and thereby achieving greater uptake of agroforestry?

What can be said is that a number of factors have the potential to reduce the cost of incentive programs and raise their environmental effectiveness:

- First, a mix of education, regulation and incentive has the greatest potential to shift attitudes and hence willingness to invest in tree planting on farms (catalytic approach);
- Second, auction systems are potentially the most cost effective way of targeting landholders; and
- Third; targeting payments to environmental benefit allows funding to be distributed to those planting of highest public value (cost-sharing approach).

It is interesting to note the different costs to revenue of the different approaches to achieve the desired level of plantings Q_d. An approach that pays equal incentives for equal work will yield a payment of P_2 at a cost of the area 0, P_2, d, Q_d. In contrast an approach that takes the best elements of all the systems could achieve the same outcome with a smaller incentive payment P_1 at a much smaller cost of the area Q_c, b, Q_d.

This discussion has served to highlight the complexity of incentive design and the challenge of engaging landholders. An approach which argues for compensating landholders at opportunity cost will yield very high costs to revenue. This is essentially the approach taken in the United States and Britain where incentive payments are much higher than those in Australia. In contrast the catalytic approach used in Australia to date could be argued to be potentially be more cost effective, although greater care needs to taken in targeting environmental benefits. The challenge is to raise landholder participation without raising expectation of large increases in incentive payments.

Markets for environmental services have the potential to achieve this outcome if well designed and linked to adequate regulations and environmental accreditation systems.

Key technical questions and research issues that arise and are discussed in subsequent sections include:

- *Coordination of existing programs and bundling ecosystem benefits* – noting that adequate incentive will not be provided to landholders until the multiple benefits (salt, biodiversity, water quality, carbon) of agroforestry can be bundled;
- *Development of markets concurrently* – developing funding sources for different environmental targets concurrently to ensure investment is not skewed to one outcome with potentially perverse on other outcomes; and
- *Property rights – balancing incentives with responsibilities* – Ensuring incentives are tied to appropriate property right instruments that secure environmental outcome in the long term.

APPENDIX 3: EXAMPLES OF A BUYER-INVESTMENT-SELLER FRAMEWORK

The buyer-investment-seller framework forms the basis of many models. Figure 8 provides some examples of the agents that may be involved in a buyer-investment-seller framework. This model would be well suited to an e-commerce operation, using the Internet to trade ecosystem goods and services between urban and rural Australia.

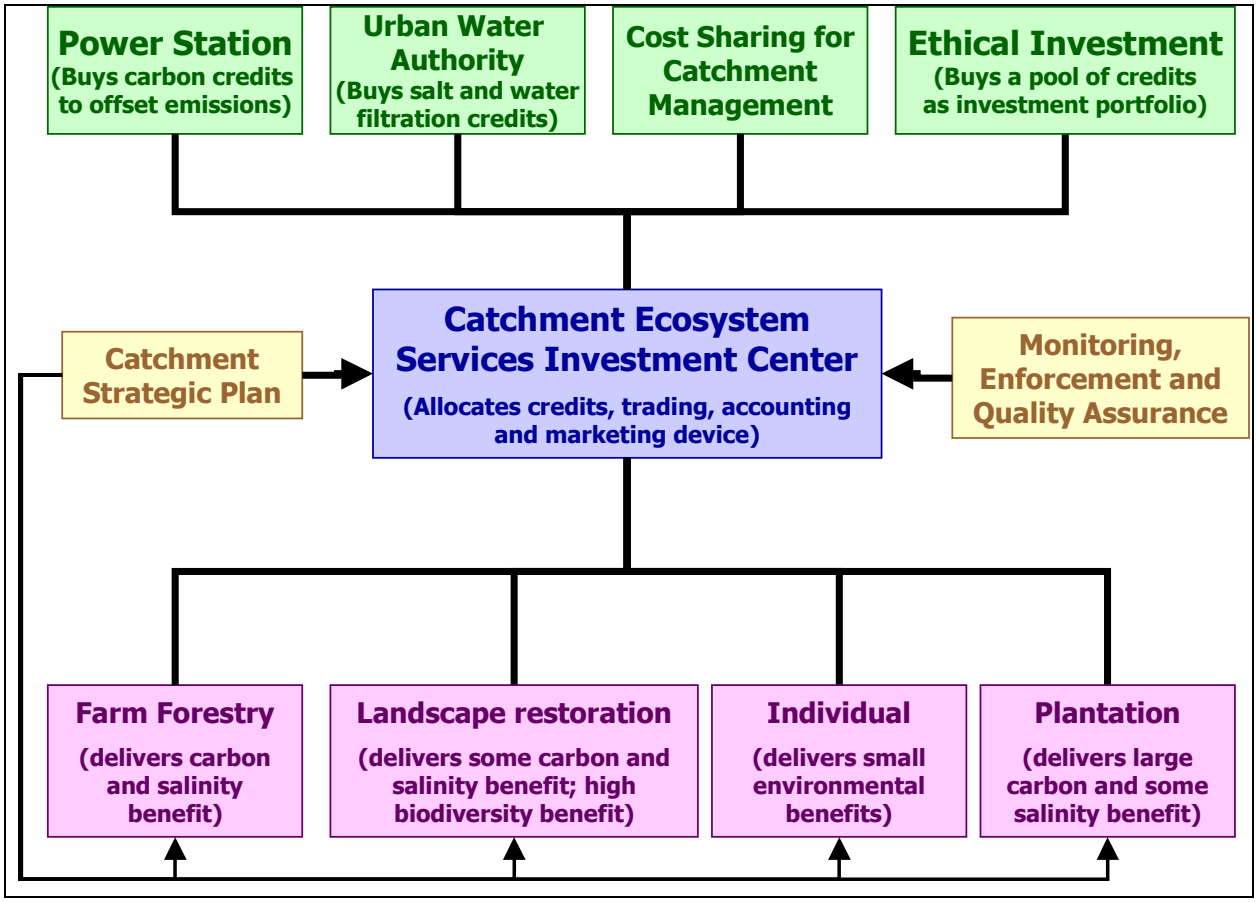

Figure 8: Potential agents in a regional buyer-investment-seller model.

As has been noted throughout the report, this framework can be made more or less complicated depending on the range of buyers and the complexity of the natural resource management objectives to be achieved.

Each of the following examples remains a variation on the buyer-investment-seller framework, which raising the same three significant questions:

1. How are **buyers** secured in order to create a demand for environmental services?
2. How are landholders engaged in **projects** to supply environmental services?
3. How are buyers and sellers linked (**investment vehicle**)?

These examples represent the more sophisticated end of the spectrum. It is important to bear in mind that simpler programs could evolve out of existing incentive programs funded by governments.

The NRM Trading System

The Natural Resource Management (NRM) trading system is shown in Figure 9. Bill Handke (pers. comm.) outlines a conceptual trading structure that would provide the financial incentive for land holders to "sell" the delivery of an ecosystem service, such as carbon, lowered water tables, remediation of dryland salinity, cleaner water, or prime habitat for biodiversity, through a trading "clearing house" to a range of buyers.

The investment vehicle in Handke's model is the "NRM Credits Pool", which acts as the dealer for trades. The investment vehicle manages the credits pool, enters into the legal contracts with landholders for the delivery of one or many environmental services. The investment vehicle then contracts and sells environmental services and commodities to buyers.

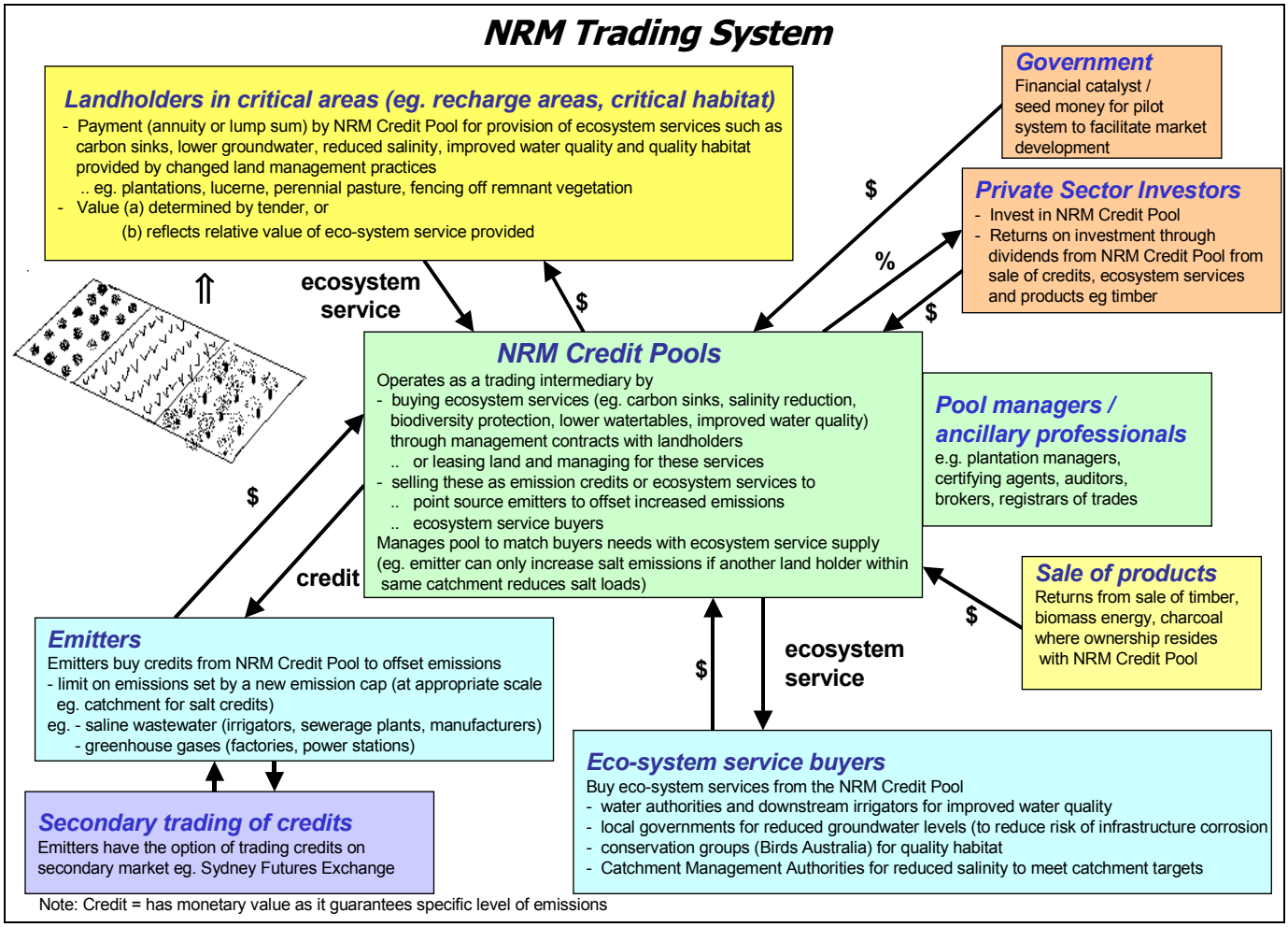

Figure 9: NRM Trading System.
Source: B Handke, Department of Natural Resources Management (pers.comm 2000)

An auction model for a tradable emissions market

This model highlights the role of auctions in tradable emission markets (Stoneham and Chaudhri 2000), advocating the use of "auction of land-use change" as a mechanism for including non-point source emitters into tradeable permit markets where these markets intersect with land use. The main components of an auction model include a seller, a set of potential buyers and the mechanism (investment vehicle) used to extract the joint distribution of valuations from these potential buyers. This model is depicted in Figure 10.

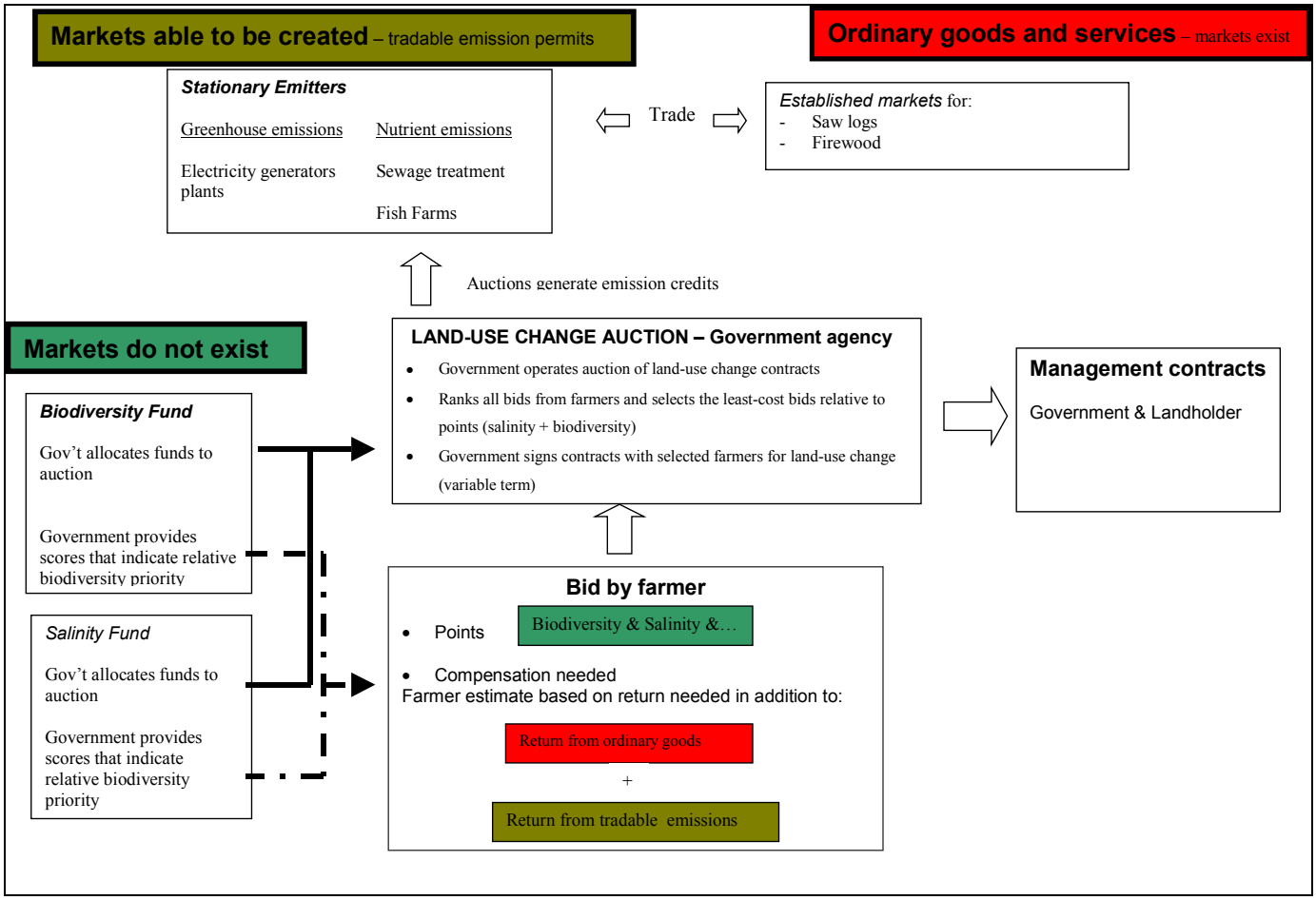

Figure 10: Auction of land-use change. Source: Stoneham and Chaudhri (2000)

A potential carbon trading market

The Sydney Futures Exchange (SFE) has proposed a model for establishing an Australasian clearing house for carbon trading. The proposed mechanism is relatively depicted in Figure 11 and involves a range of players including dealers/brokers, financiers and accreditation agencies working through a clearing house established through the exchange. Even though the SFE has decided to halt the development of the world's first exchange-traded market for carbon credits, the process produced a useful mechanism to consider under the buyer-investment-seller framework.

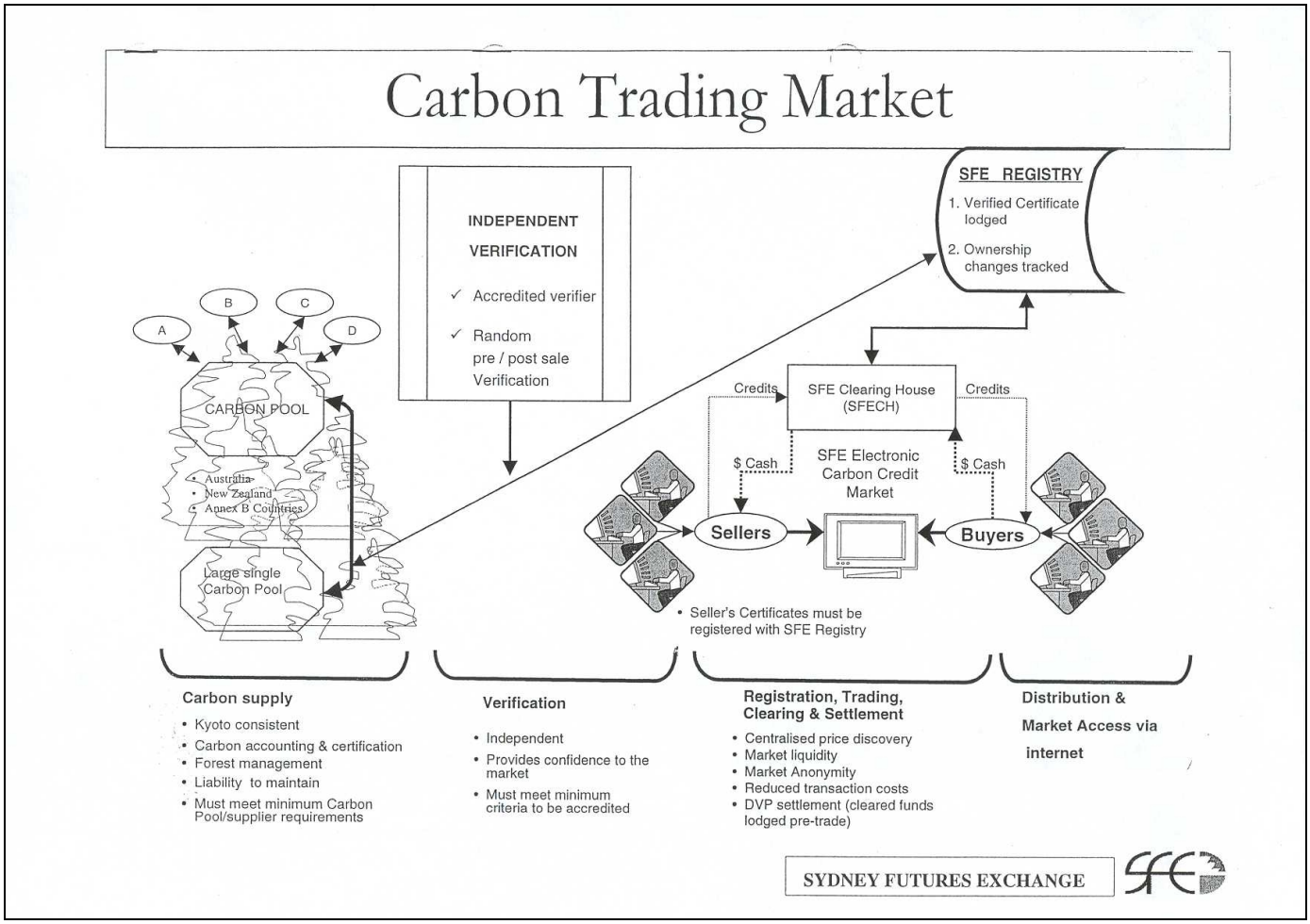

Figure 11: Structure of a potential carbon trading market. Source: State Forests NSW

APPENDIX 4: CONCEPTUAL DESIGN OF AN INVESTMENT VEHICLE

The following figures attempt to map the role of agents involved in a buyer-investment-seller framework. There are several agents that interact with various components of the investment vehice. These include investors, projects, traditional buyers, developers/emitters, and accreditation, monitoring and enforcement agents. Each agent trades with money to receive a variety of outcomes. An ecosystem credit is undefined at this stage, however may include carbon credits (well established), biodiversity credits, salinity credits, water purification credits, or even green energy credits.

The investors, or buyers, have different motivations for investment:

- Government Investor – Initially injects money as a catalyst to help establish the buyer-investment-seller framework and subsequently leverage private investement. Their primary aim is to invest government dollars for public good. Additionally, government departments may be interested in acquiring ecosystem credits for future trading (such trading would necessarily be for the public good).
- "Green" Investor – Receives personal fulfilment. Such investors may include individual donations or corporate sponsorship. There is no transfer of proprietary rights.
- "Brown" Investor – Will receive corporate image, however may be more interested in receiving ecosystem credits for future trading, viewing this as a better option than a simple financial return.
- "Ethical" Investor – Primary motivation is a financial return on investment. Investors are making increasing demands on fund managers to invest ethically as well as provide a competitive return. Such investors also receive corporate image (fund manager) and personal fulfilment (individuals). Ecosystem credits are not transferred to ethical investors.

These types of investors are becoming increasingly important players in achieving environmental outcomes. Reflecting a shift in societal values, ethical or social investment has developed in finance and accounting in the last decade (Beal and Goyen 1998). Investors have many complex goals and investment objectives – they seek competitive returns and more. Such social value investors are currently changing the economics of the American tabacco industry, and account for $1.1 trillion in managed assets in the USA alone (Henderson 1998). Beal and Goyen (1998) examined the Australian company Earth Sanctuaries Limited (ESL), finding that the environmental mission of ESL took precedence over financial considerations. ESL currently has over 6,500 shareholders, with a projected profit of $2 - $3 million per annum (ESL 2000).

Investors in a market for environmental services would deal with a clearing house, possibly through the use of a unit trust. A unit trust is a legally-constituted mechanism, which provides the pooling of investor capital and its investment in income-producing assets (James et al. 1995). The net returns from such investments accrue to the unit holders (investors) in the form of price appreciation and unit holder distributions, the latter being equivalent to company dividends. Investing in a unit trust is similar to buying shares in a company, however the majority of unit trusts operate simply as vehicles for the holding of investments, as opposed to being active sellers of goods and services in the market (James et al. 1995).

All components of the investment vehicle would require an independent agency with regulatory powers to accredit, monitor and police dealers and projects.

A dealer would be linked closely to the clearing house to manage the stocks and flows of ecosystem credits. This arrangement is shown in Figure A below. Note that the clearing house is able to sell traditional products, such as timber or biomass, to maintain an additional source of income. It would

be feasible in some cases that some projects may wish to retain their traditional product and only supply ecosystem credits – this would be negotiated with the dealer.

In Figure 13, private investors provide some financial capital (for various reasons), however no caps or targets are in place, therefore government is left to provide critical funding to maintain the system.

Figure 14 depicts the model after a cap or target is put in place, thus creating additional agents. Investment is now provided via developers or emitters wishing to expand. The private sector is forced to purchase ecosystem credits, so that government has a lesser role in maintaining the system. Additionally, government (or the "brown" investor) may opt to sell credits gained before a cap was initiated through a broker. It is assumed that developers or emitters would pass on some of the new costs of acquiring ecosystem credits to the urban population, while at the same time re-marketing themselves with a "green" image.

Figure 15 provides some potential examples of the players in such a model.

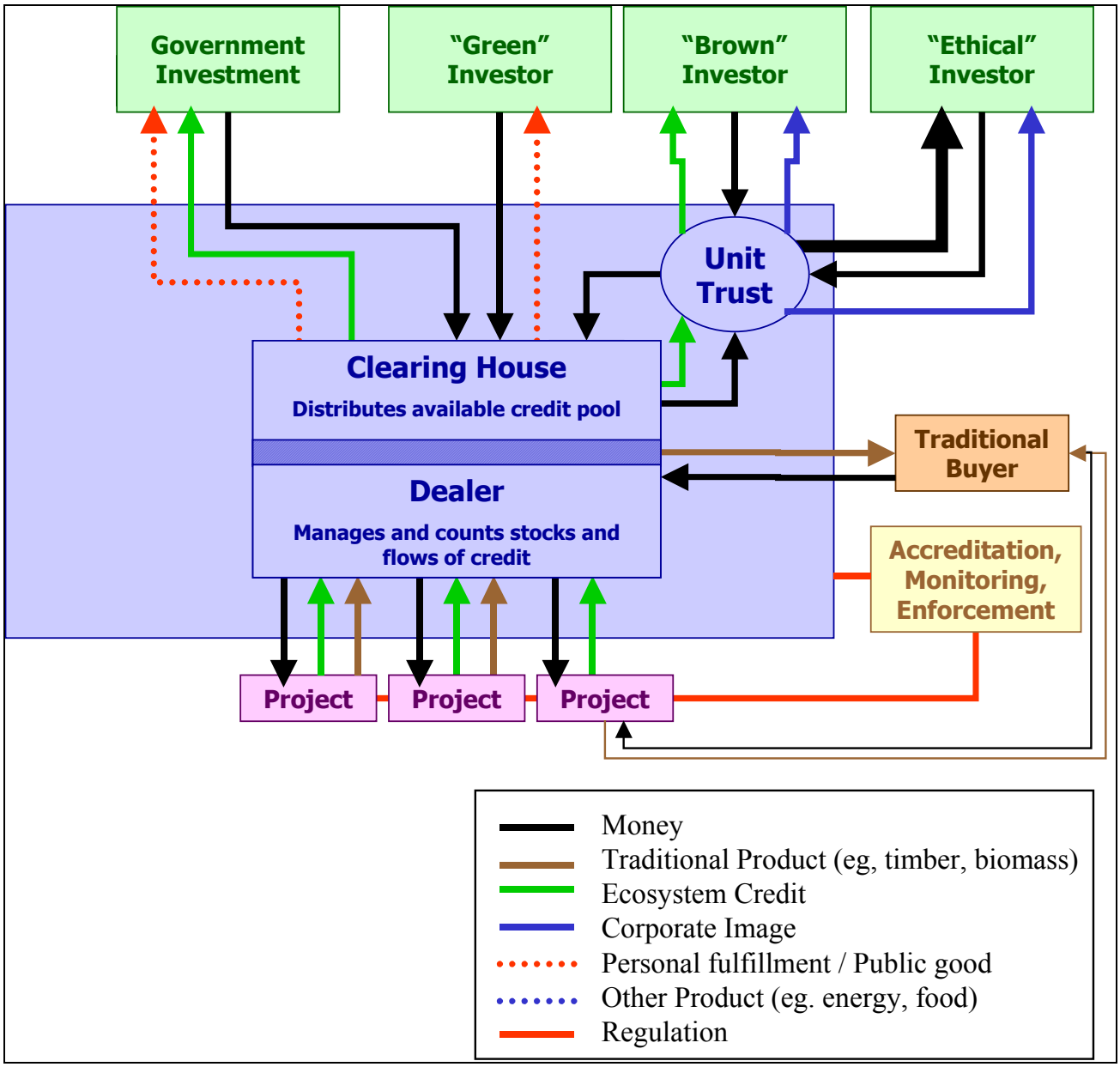

Figure 13: Design of an investment vehicle without a cap. Note large role of government. This arrangement will not generate a significant revenue change in private investment towards environmental goals.

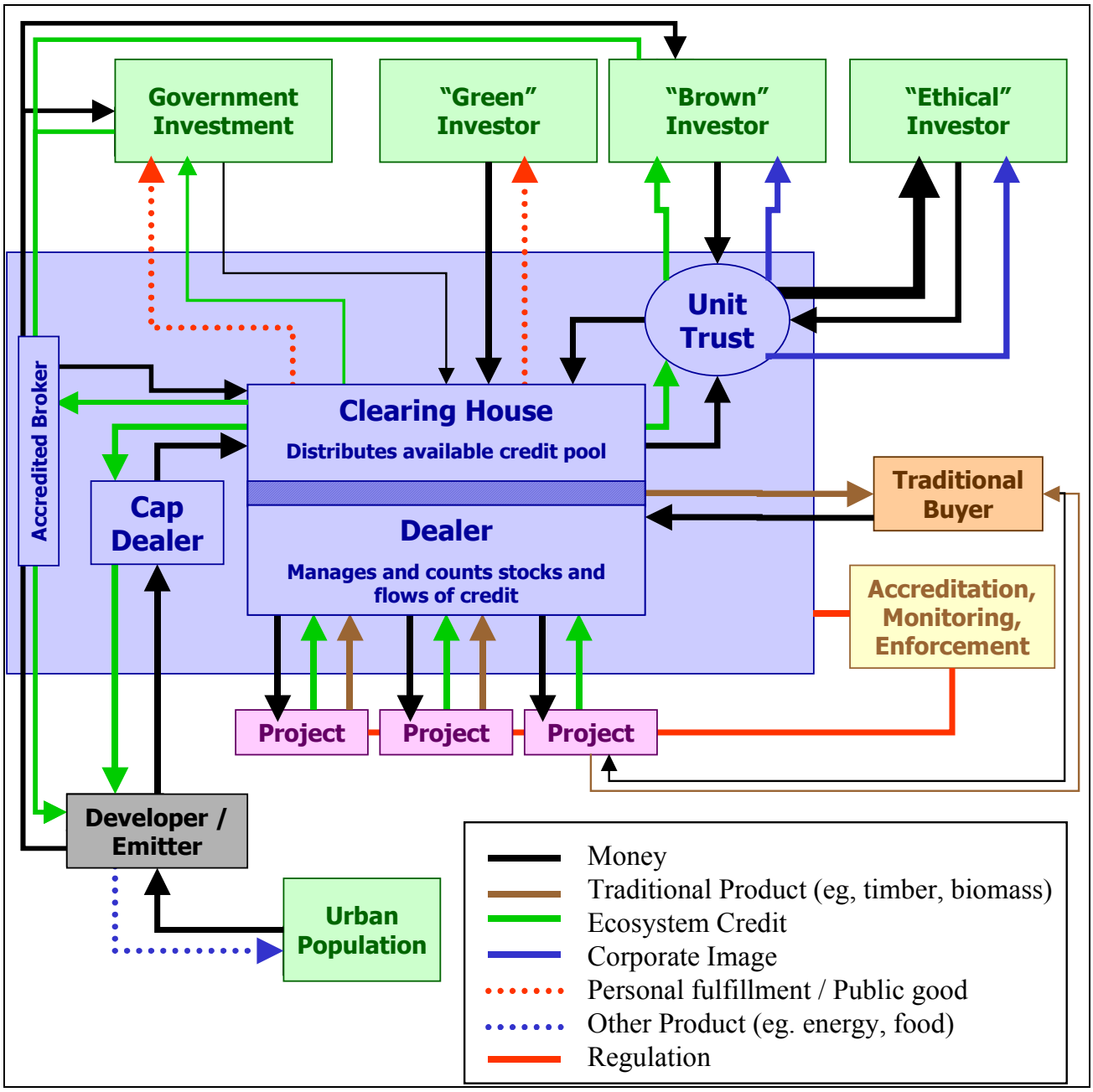

Figure 14: Design of an investment vehicle with a cap. Note addition of agents and lessened role of government. This arrangement will generate a significant revenue input from the private sector, assuming adequate regulatory backing of a cap.

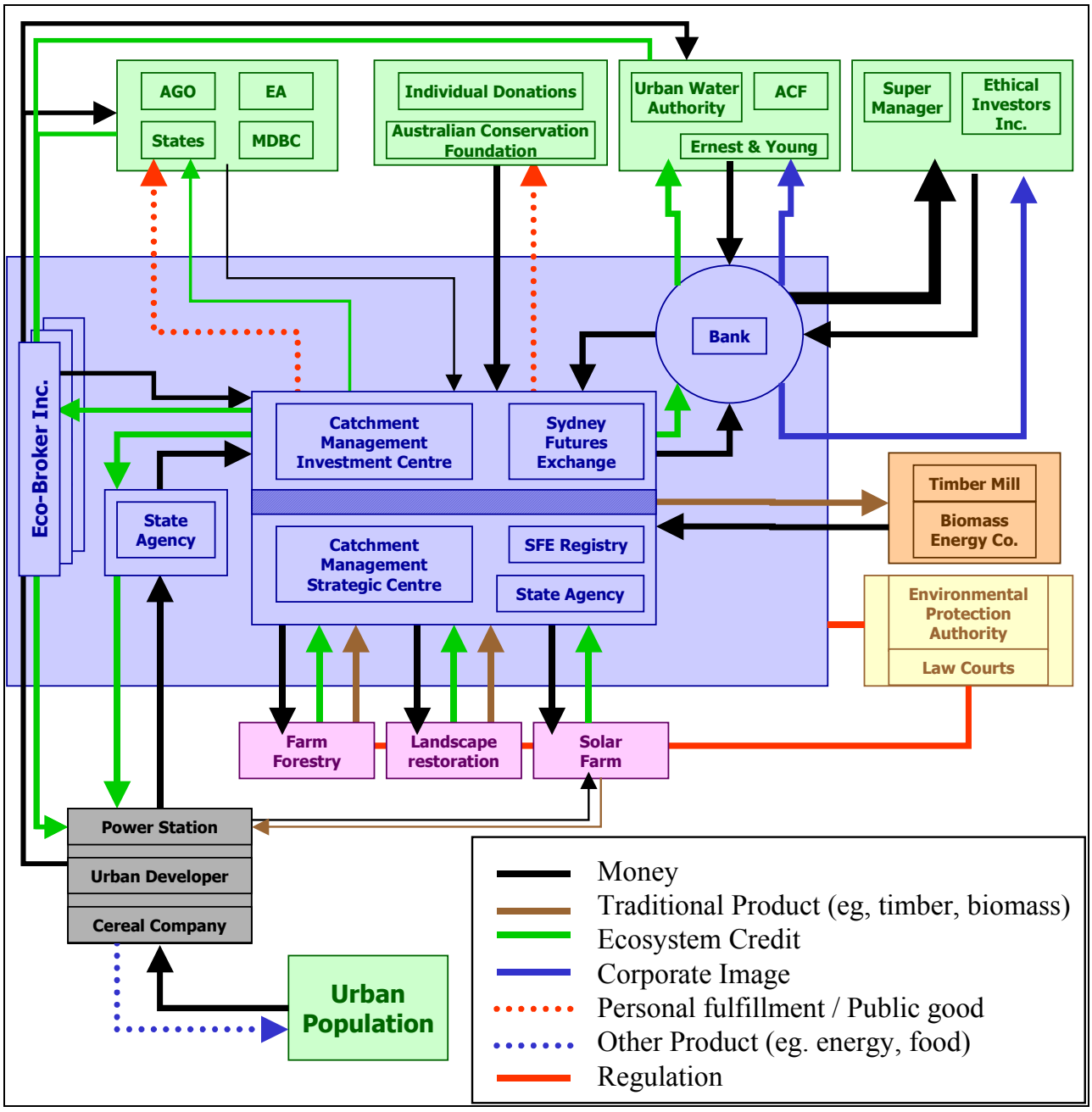

Figure 15: Design of an investment vehicle showing examples of potential players.