The widespread failure of small farm woodlots that were modelled on industrial forestry methods lead to much of the early farm forestry research and development focusing on the identification and promotion of "best bet" options. The expected costs and returns from promising timber production options were compared with agricultural gross margins and presented to farmers as "recipes for success" that were suggested as more profitable than their current land use.

Many farmers willingly tried to follow the recipes provided by the experts. Failure and frustration was common. In many cases the pre-defined options were simply unsuitable for the sites where the farmers wanted to grow trees. The models were also insensitive to the variability within the social and economic landscape of rural communities. The individual needs, resources and aspirations of the farmers rarely matched those assumed by the researchers when they designed and evaluated the options.

The infinite possibilities inherent in agroforestry and farm forestry, and the fact that farmers' needs, resources and aspirations are so varied, mean that a recipe approach to system design is unlikely to be effective. There are simply no “best-bet” species, spatial arrangements or management prescriptions that will be suited to more than a few growers within a region.

At first, the lack of clear options makes getting started in farm forestry appear difficult but for committed farmers this provides a welcome opportunity to develop their own farm forestry designs.

This doesn't mean that all farmers are starting from scratch: there are many promising designs being developed by leading farmers within each region and many others being tested by researchers that can be adapted to fit a particular situation. What is needed is knowledge about the flexibility of these options, some understanding about how they can be manipulated to fit an individual's requirements and a guiding framework for the design and evaluation of possible options.

The Australian Master TreeGrower Program seeks to help equip farmers with the skills and understanding to allow them to develop and evaluate designs tailored to their own requirements and aspirations.

This chapter outlines a framework by which farmers, either alone or as a group, might design and evaluate appropriate farm forestry opportunities. Extension agents and researchers can also use the design framework to highlight opportunities for supporting farm forestry and defining research questions.
The Master TreeGrower design framework

Our approach to designing farm forestry opportunities begins by simply asking the question: "Why would you want to grow or manage a forest?" The responses in any group of farmers will vary widely but can be loosely related to their financial, environmental, agricultural, non-agricultural or personal goals:

- **Financial goals**: investment, diversification, deferring income, utilising unproductive land, enhancing property values, providing on-farm employment etc.
- **Environmental goals**: controlling land degradation, enhancing natural habitats, screening offensive industries, improving water quality etc.
- **Agricultural goals**: shade and shelter; controlling vermin and noxious weeds, recycling or fixing soil nutrients, fodder for stock etc.
- **Non-agricultural goals**: enhance tourism potential, develop new skills and job opportunities, establish a forestry related on-farm business, etc.
- **Personal and lifestyle goals**: wishing to leave a legacy; watch a forest grow, learn about the natural environment; improve the view etc.

Farmer participation in forestry is driven by a diverse and complex set of motivations and constrained by an equally diverse range of limitations. Identifying clear motivations is the first step to designing appropriate farm forestry options.

Whole business planning has been widely promoted within the farming community under terms such as Whole Farm Planning or Property Management Planning. These approaches use a number of tools to help farmers define their forestry related goals and personal performance criteria. Mapping the farming enterprise using aerial photographs is one method that can help identify areas where trees or forest management may be able to contribute to the farm goals. Areas considered unsuitable for production agriculture might be identified on the map as the first step to designing farm forestry options. Another example is the boundaries between different land classes. These are often ideal locations for belts of trees for shelter and land protection.
Balancing multiple goals
As farmers list and prioritise the full range of objectives they are seeking from their forests the importance of careful planning and research becomes clear. Unfortunately, multiple objectives are not always complementary. Managing a shelterbelt, riparian strip or recharge plantation for commercial timber will require strategies to avoid any unacceptable impacts of harvesting on the non-timber benefits. Good design will require some understanding of the complementary or competitive relationship between different objectives and the compromises required in order to achieve an appropriate balance.

Strategies to deal with conflict, may incur additional management costs or lower than optimal production of a particular product or service. It is common for farmers to accept these losses and costs in order to reduce the risks associated with single purpose forestry. In fact, rather than being "good for nothing" multipurpose designs often carry lower risk and are more adaptable as the following examples illustrate:

I. TIMBER PLANTATIONS FOR SALINITY CONTROL
Revegetation of recharge areas is widely acknowledged as a possible means of controlling the rising watertables that contribute to dryland salinity. Hydrological surveys often identify the principal recharge areas as the cleared well-drained hillslopes where water easily penetrates. To control the recharge farmers are often advised to establish a canopy of evergreen perennial vegetation that can dry the soils to depth or intercept subsoil drainage. The trees or shrubs do not necessarily need to be indigenous, or even native, but they must be able to grow well on the site and survive the likely droughts and other threats. The costs associated with revegetation and the subsequent loss of agricultural production from the planted area represent a real and substantial investment, whereas the environmental return is often uncertain and difficult to describe in dollar terms.

Depending on the farmer’s other interests, they might consider establishing a commercial plantation on the recharge site. If an industrial forestry company is offering a commercial joint venture or lease, they may be able to negotiate for a plantation to be established on the site. To be effective for salinity control the plantation must be located correctly, remain productive and be harvested in a way that doesn’t allow recharge to return to the pre-planting levels. This may mean that conventional plantation species or management methods are inappropriate. Blue Gum (E. globulus), for example, is susceptible to drought deaths on dry, well-drained sites so alternative, although less vigorous, species such as Sugar Gum (E. cladocalyx) may be more suitable. Such areas are also often difficult to access and expensive to harvest making production of low value products like pulpwood unviable, whereas sawlogs may be viable to harvest due to higher log values.

Although the site may not be ideal for production forestry the farmer may be willing to accept a lower return in order to achieve salinity control. This may mean lower lease payments or lower prospects of deriving a profit from the timber. Where the costs of establishing a non-commercial forest are inhibitive, the multipurpose option reduces the farmer’s exposure to risk while meeting their most critical environmental concerns. The fact that the plantation is not "viable to establish" on the basis of timber production alone is not critical. What is important for timber production is that the trees are “viable to harvest” at some time in the future.
2. SHELTERBELTS WITH A TIMBER OPTION

It is widely accepted that a conventional sheep and cattle grazing enterprise in southern Australia can increase, or at least maintain, agricultural production if trees are planted strategically over about 10% of the farm. Depending on the situation, the trees may need to be established in continuous narrow belts aligned to reduce damaging winds as well as in special areas for stock shelter during lambing and calving or immediately after shearing.

If the farmer is able to achieve these design criteria by including timber species managed for high value markets they might be able to develop a valuable resource that can be harvested when needed. The costs of fencing, establishment, and the land itself can be justified from the shelter benefits alone. The only additional expense is some time spent researching possible timber markets and silvicultural options and the cost of a few hours extra management to ensure the trees produce a saleable product. In any event, the risks and costs are dramatically reduced because of the multiple values. If, for whatever reason, the trees are unsaleable when mature the farmer still has the shelter and other values to enjoy.

3. FORESTRY FOR ECONOMIC DIVERSIFICATION

Investing in forestry on the less productive parts of the farm may be a means of building income security without threatening conventional production. Agricultural returns are susceptible to poor seasons and fluctuating markets. Timber, seed and other tree products commonly have markets that are unrelated to those of the agricultural commodities like wool and beef. Some tree products, like timber, remain available for harvest even through poor seasons.

Forestry may also offer taxation, superannuation and generational transfer attractions for farmers. By investing in a long term venture that will mature well into the future, farmers may be able to ensure they have sufficient funds for their own retirement without the need to draw resources out of their children’s agricultural enterprise.

A thorough diagnosis of the farm’s business situation and the family’s investment objectives may be required to ensure that any farm forestry project reflects their particular situation and their preparedness to commit resources to what may be a long and risky investment. The best design is the one that matches the farmer’s own performance criteria without exposing them to an uncomfortable level of risk.

The perfect compromise

The simple graph in Figure 1 illustrates why many farmers will prefer multipurpose farm forestry designs in preference to “best-bets” that maximise single values. Because farmers are able to capture many of the non-timber benefits offered by forests they may, for example, accept higher costs, slower growth or lower returns from a commercial plantation if this means that it will also provide wildlife and shelter benefits. By the same token, a farmer planting trees for shelter or land protection may be willing to accept the additional labour costs associated with managing some of the trees for timber just to keep that option open.

If farmers are seeking multiple benefits they will need to clearly specify their priorities and the minimum requirements for each outcome. This is where farmers will need to do their homework. If, for example, shelter is the primary goal then understanding the principles of shelterbelt design allows...
INTEGRATING FARM FORESTRY INTO YOUR FARM

the farmer to prescribe a layout that will provide sufficient shelter in the right location at the right time. Even where commercial production of forest products is not a primary concern the farmers must be sure that their mature forests will be “viable to harvest”. Timber production cannot be considered a “bonus” if it costs more to harvest than it is worth.

When defining goals be specific. If shelter is sought then specify what is to be sheltered (sheep, crops, pasture etc), when shelter is required (eg summer, winter, off-shears) and where (eg near the shed, across the whole top paddock). If expecting a commercial income from trees, note the desired investment period (10, 20 or 30 years), attitude to risk (eg happy to aim for high return despite high risk), and any taxation or superannuation implications.

The Joint Venture Agroforestry Program’s book, Design Principles for Farm Forestry - A guide to assist farmers to decide where to place trees and farm plantations on farms, is used as a companion to this book during the Master TreeGrower Programs. The book summarises Australian research on the role of trees in providing a wide range of benefits. It guides farmers in the design of forests to meet particular needs including salinity control, shelter, biodiversity, landscape values and erosion control. An important feature of the book is its emphasis on understanding the positive and negative interactions between trees grown for different purposes and with agricultural production.

Summarise the goals

In many cases farmers will be able to identify a range of objectives some of which will be essential to the success of the planting and others which are desirable but not essential. It is also useful to identify the following:

- **Must haves** - what the project must provide to satisfy
- **Like to have** - extra benefits that would be welcome
- **Must nots** - characteristics or outcomes that must not result
- **Prefer nots** - characteristics or outcomes that should be avoided

These goals help highlight the design criteria that must be achieved in order to satisfy the farmer's objectives, those that are common to different objectives and those which may initially appear contradictory. This then
becomes the "shopping list" that can be used to compare different types of forestry before committing to a project plan. If the products or services produced by a forest are to be sold, then some market research as to the product specifications required by potential purchases and the marketing options is required.

**Markets for products and services**

Farm forests can be designed and managed to provide a wide variety of products and environmental services for which there may be a commercial market. Timber is only one such product. Others include oils, seed, foliage and Christmas trees. Environmental services that might be saleable include carbon sequestration, improved water quality, biodiversity and recharge control. In fact, anything that an individual, organisation or government may be prepared to purchase can be considered as a potential source of income. Remember that markets for forest products and services can change. It may also be worth giving some thought to what may be considered of value in the future and build this into your design.

Timber is a useful example to illustrate the importance of market research. Growers must appreciate that the value of a "good" log, at the mill door, is many times that of a "poor" log. This will generally be reflected in the price, but may also be evident in the level of market interest and the preparedness of log buyers to undertake the sale on your terms. It is common for farmers with small forests containing average logs to find they are the last in line when it comes to arranging a harvest.

The next graph (Fig 2) shows, for one hardwood mill, how the value of a sawlog is greatly influenced by diameter and log length. In this mill the "optimum" log size is 45 centimetres in diameter and 5.4 metres long. Logs falling below the line due to their length or diameter are uneconomic to mill. Farmers should talk to timber processors in their region about what constitutes a perfect log and ask them how they see the market changing in the future.

Because harvesting and wood transport costs are affected by lot size and site conditions, it is also worth considering forest specifications. Farmers need to consider their harvesting options and then talk to contractors about what affects logging costs. Small plantations on steep sites are expensive to harvest and may only be viable if the trees are very valuable. Farmers wishing to grow forests for environmental services or other non-timber purposes should talk to processors to learn about specifications.
to harvest the trees themselves need to consider what skills they might require and what tree and stand specifications might affect their cost. Chainsaws and farm tractors may only be effective where log size and quality is high and the stand is open with easy access.

**Silviculture - manipulating forest growth**

Silviculture is essentially the manipulation of forest growth through design and management. Careful species selection, planting pattern and site preparation can set a young forest up so that it has the best chance of success. Once established, the timely use of various tools such as fertiliser application, pruning, grazing, fire and thinning can help direct future growth in any number of ways.

Whatever the benefits we expect from a forest, silviculture can be used to balance or enhance them. Thinning might be a means of increasing the proportion of high value sawlogs in a native forest or enhancing biodiversity by stimulating understorey plants. Grazing can be used to reduce fire hazards while also providing shelter for stock. While site characteristics, climate and changing markets will also affect the growth and value of a forest, silviculture remains the most powerful tool of the farm forester. By the same token, poor silviculture or neglect can result in land degradation, poor productivity or low production values.

Where there are clear market specifications it is important to be able to measure a forest to assess its value and gauge its response to different silvicultural interventions. Standard procedures for measuring and describing the timber volume within a standing tree or forest are described in a later chapter. Measures such as species composition, stocking rates, canopy closure and basal area are also useful in assessing the value of a forest for land degradation control, carbon storage and even wildlife value.

**Designing and evaluating options**

Coming up with a farm forestry project plan that is "profitable" and "appropriate", based on the farmer's needs, constraints and opportunities, is a question of design. A useful starting point is to try and visualise what your perfect forest might look like. This provides a focus for deciding on the
species, design and management required and may help identify risks and uncertainties. Farmers should shop around for promising options based on the experience in their region and make notes on the advantages and disadvantages of each.

Economists generally use a discounted cash flow to calculate a Net Present Value (NPV $/ha) in order to test and compare the viability of different investments. Before accepting the outcome of such analysis, farmers need to be sure that the criteria used, and the assumptions on which they are based, are relevant to their particular circumstance. For example, forestry ventures are often selected on the basis of their predicted Net Present Value per hectare of land. For a farmer who has plenty of land requiring revegetation, but is limited by the costs associated with planting and managing the trees it may be more appropriate for them to compare options on the basis of their NPV per dollar invested or NPV per hour spent working in the forest.

In some cases it will be near impossible to put a dollar figure on a farmer’s personal performance criteria. What value can be placed on enhancing the attractiveness or amenity value of the family farm if there is no intention of selling it? If landscape is an important consideration, try and visualise how the forest will look as it grows and then describe your preferences and dislikes. There are computer models that can help do this, but the best starting point is to visit other farms where farmers are doing similar things and make your own judgement.

By referring back to their original goals and constraints, farmers can make a final decision that they are comfortable with supported by economic analysis, risk assessment and personal preference. All farmers need to make their own judgement and appreciate that what is right for them may not be appropriate for others, even their neighbours. If it appears impossible to develop a practical and attractive design that involves an acceptable level of risk then the farmer should not proceed. This should not be seen as a failure of the process but rather a means of avoiding disappointment. If this is the case, farmers should keep an eye open for new opportunities or changing circumstances. Farm forestry is a dynamic industry with new methods and markets continually being developed.
Farmer aspirations and market opportunities

To realise the full potential of farm forestry we need to avoid the temptation to promote or accept someone else's "favourite" or "pet" planting models. The Master TreeGrower approach gives all possible designs, including conventional industrial plantations and non-commercial options, equal attention and encourages farmers to play an active role in the design of their forestry systems.

Farm forestry design should not be "top down" or "bottom up", but rather "inside out". Farmers and their communities need to be encouraged to look for opportunities whereby forestry can help solve their immediate needs while providing the prospect of generating the products and services that others are prepared to pay for. Regulations and market impositions that stifle good design and innovation must be challenged.

Those with an interest in the products and services of farm forestry need to ensure that farmers understand their "product" specifications and are able to negotiate a viable "sale". Where they have the knowledge and the price is right, farmers will be able to produce and sell timber, erosion control or biodiversity in the same way they sell lamb or milk.

To be successful, farmers must own their projects, accept responsibility for the management decisions and be able to negotiate the sale of products and services in a fair market place. Farmers must be the "chefs" not just the "cooks". The Australian Master TreeGrower program is about ensuring that farmers are able to take on this role and work alongside governments, researchers, extension agents, processors, investors and community groups for mutually beneficial outcomes.

Farmers can produce and sell products and services from multipurpose forests in the same way they produce milk or wool from pastures.
Master TreeGrower Design Framework

**FARMER’S DESIGN CRITERIA**
- Farmer’s goals, aspirations, available resources and constraints
- Role trees and forests must play to meet goals within constraints
- Project design criteria, performance measures and attitude to risk

*What the farmer wants*

**MARKET SPECIFICATIONS**
- Stakeholder interest in forestry and their willingness to pay or penalise
- Market specifications for the trading of forest products and services
- Target tree and stand characteristics required to meet market specifications

*What the market is seeking*

**DESIGN**
- Compare farmer and market needs to identify the compromises and complementary
- Build up multipurpose designs based on farmer priorities and market specifications
- Review silvicultural options that can deliver multipurpose designs
- Identify variables within each design that can be varied by the farmer

**EVALUATION**
- Test effect of changing the design variables against design criteria, performance measures and attitude to risk
- Compare options: accept or reject

MTG Design Framework for multipurpose farm forestry: Diagnosis, Design and Evaluation