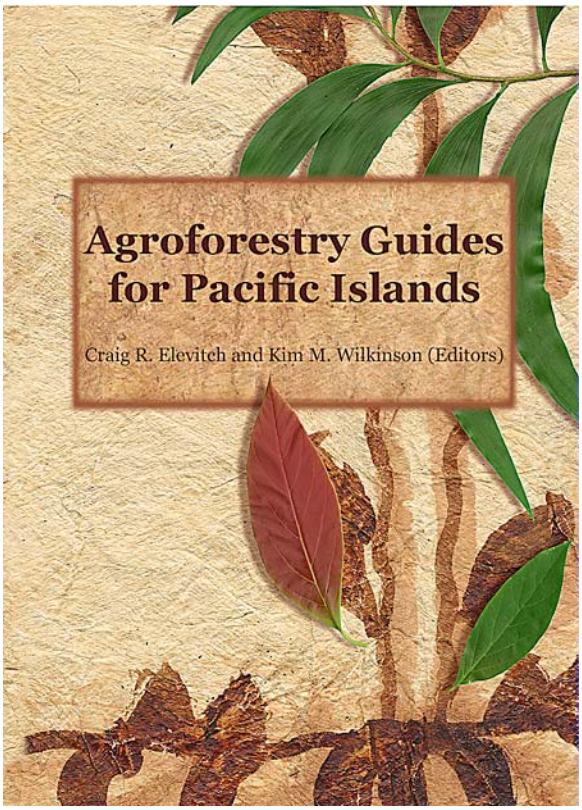
For Educators, Gardeners, Farmers, Foresters, and Landscapers

Agroforestry Guides for Pacific Islands



"Well-researched, concise, user-friendly...an invaluable practical resource for those working to conserve and expand the use of trees in agricultural systems."
—*APANews*, The Asia-Pacific Agroforestry Newsletter
FAO Regional Office, Bangkok, Thailand

"A significant contribution to public education, advancing the cause of integrated agriculture and forestry...a resource of lasting value."
—*The Permaculture Activist*, North Carolina

"A most excellent handbook...a wonderful resource."
—Developing Countries Farm Radio Network, Toronto, Canada

"Eloquently makes a case for reintroducing and emphasizing trees in our island agriculture."
—Dr. Bill Raynor, Program Director, The Nature Conservancy, Pohnpei, Federated States of Micronesia

"Provides a real clearinghouse on traditional and modern agroforestry not only for Pacific Islands, also very useful for other regions."
—*ILEIA Newsletter for Low External Input and Sustainable Agriculture*, The Netherlands

Purchase the book at http://www.agroforestry.net/afg/

Agroforestry Guides for Pacific Islands
edited by Craig R. Elevitch and Kim M. Wilkinson

Price: $24.95 (plus shipping)

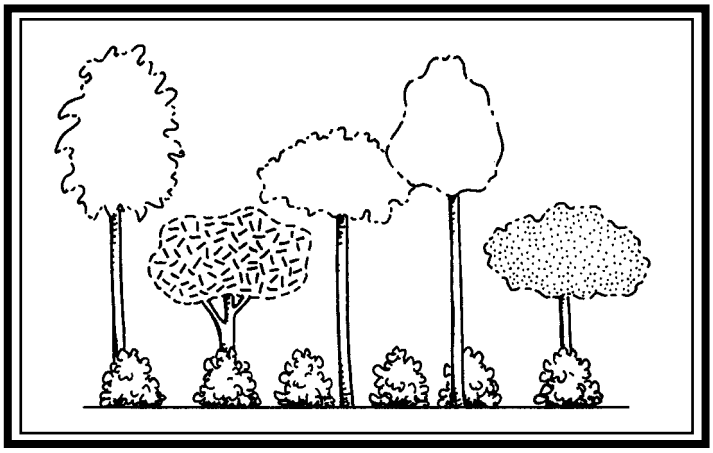
Availability: Usually ships within one business day.

Paperback - 240 pages, illustrated and fully indexed
Release date: September, 2000
ISBN: 0970254407
Publisher: Permanent Agriculture Resources, P.O. Box 428, Holualoa, HI, 96725, USA. Tel: 808-324-4427, Fax: 808-324-4129, email: par@agroforestry.net

Agroforestry Guides for Pacific Islands #7

Economics of Farm Forestry: Financial Evaluation for Landowners

by Craig R. Elevitch and Kim M. Wilkinson



PAR

Western Region
Sustainable Agriculture Research and Education

www.agroforestry.net

Economics of Farm Forestry: Financial Evaluation For Landowners

Abstract: The decision to invest in a farm forestry project involves many issues for private landowners. Farm forestry is a long-term investment of land, labor, and resources. It is important that the landowner carefully consider the economic prospects of the practice before investing.

This guide introduces techniques that can be used to evaluate the financial returns of farm forestry projects. Also introduced are ways to improve or diversify returns with agroforestry, value-added strategies, and market positioning.

Keywords: farm forestry, agroforestry, forestry, tree farm, financial evaluation, nontimber forest products, value-added, private forestry, small-scale forestry

Contents

Introduction **3**
- *What is Farm Forestry?* ***3***
- *Benefits and Drawbacks of Farm Forestry* ***3***

Financial Evaluation **4**
- *Why Financial Evaluation for Farm Forestry?* ***4***
- *Financial Analysis for Farm Forestry* ***5***
- *Basic Steps for Forestry Financial Analysis* ***5***
- *Determining Costs* ***6***
- *Major cost categories* ***7***
- *Estimating Returns* ***10***
- *Farm Forestry Cash Flow* ***11***
- *Discounted Cash Flow* ***12***

Analysis Tools Using Discounted Cash Flow (DCF) **14**
- *Relative returns of farm forestry* ***14***
- *Net Present Value* ***14***

Sensitivity Analysis **15**
- *Uncertainty Factors* ***15***

Including the Additional Benefits of Trees **18**
- *Comparison with Other Land Uses* ***18***

Improving the Economic Picture **20**
- *Timber Products: Value Added Strategies* ***20***

Agroforestry to Improve Economic Benefits **22**
- *Short-term Nontimber Yields (Sequential Cropping Systems)* ***22***
- *Sustained Nontimber Yields* ***24***
- *Silvopastoral Systems (Timber Trees and Livestock)* ***25***
- *Multipurpose Timber Species* ***26***

Resources and Recommended Reading **27**
- *Local Assistance* ***27***
- *Societies and Organizations* ***27***
- *Certification Programs* ***28***
- *Web Links* ***28***
- *Periodicals* ***29***

Acknowledgments **29**

About the Authors **29**

References **30**

Guides **31**

Authors: Craig R. Elevitch and Kim M. Wilkinson, **Illustrator:** Christi A. Sobel

Reproduction: We encourage you to share this information with others. All or part of this publication may be reproduced for noncommercial educational purposes only, with credit given to the source. For commercial reproductions, contact the publisher. © 2000 Permanent Agriculture Resources. All rights reserved.

Electronic distribution: Download this publication and others in the series at http://www.agroforestry.net

Publisher: Permanent Agriculture Resources, P.O. Box 428, Holualoa, HI 96725 USA; Tel: 808-324-4427; Fax: 808-324-4129; E-mail: par@agroforestry.net; Web site: http://www.agroforestry.net

Citation: Elevitch, C.R., and K.M. Wilkinson. 2000. Economics of Farm Forestry: Financial Evaluation for Landowners. Agroforestry Guides for Pacific Islands #7. Permanent Agriculture Resources, Holualoa, Hawaii, USA. Web site: http://www.agroforestry.net

Acknowledgments: Contributions of material were made by Rowan Reid and Peter Stephen, The Australian MasterTreeGrower Program, School of Forestry, The University of Melbourne.

Sponsor: Publication of this guide was made possible through a grant from the U.S. Department of Agriculture's Western Region Sustainable Agriculture Research and Education (WSARE) Program. This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, and Agricultural Experiment Station, Utah State University, under Cooperative Agreement under 98-COOP-1-6481.

000613

Introduction

What is Farm Forestry?

Farm forestry is the planting and management of trees for timber yields by farmers. Farm forestry can take many forms, from reforestation of fallow land to the integration of timber trees with existing farm practices such as pasture, orchard, or other crops. Some farm forestry projects resemble small-scale forest plantations; others are more diversified agroforests. Projects can range in size from very small (one acre) to very large (hundreds of acres). Farm forestry has the potential to produce quality timber products, increase farm incomes, support community development, and provide employment and environmental benefits.

Often the term "forestry" has been associated with large-scale single-species plantations managed exclusively for commercial return of a timber product. Indeed, much of the scientific and economic study of forestry has been devoted to the needs of this industrial form of forestry. While the farm forester shares the goal of commercial timber returns, she or he otherwise may have a very different set of resources, needs, and objectives as compared to the industrial forest investor. This guide is intended to assist private landowners and farmers with the economic assessment of farm forestry.

This guide will guide the reader to:

- Estimate the financial returns of farm forestry using some simple analysis techniques.
- Compare different forestry scenarios with other agricultural activities.
- Assess the impact of uncertainty factors such as returns, market conditions, and natural disasters on the economic analysis.
- Consider strategies to improve or alter the economic picture including diversified plantings (agroforestry), and value-added practices.

Benefits and Drawbacks of Farm Forestry

Farm forestry differs from large-scale commercial forestry in a number of important ways. Some of these differences can work in the farm forester's favor; others may be a disadvantage. In most cases, it is unrealistic to assume that the small-scale grower can hope to compete in the same markets, and with the same product line, as large-scale industrial plantations. The farmer must instead understand the advantages and disadvantages of their situation in order to optimize the potential for an economically viable forestry planting on their property.

One of the main differences between farm forestry and industrial forestry is that farm forestry includes intimate landowner involvement in all phases of planning, implementation and long-term management. The smaller scale of farm forestry projects and the higher level of personal involvement puts farm foresters in a position to benefit from many economic or environmental products of the forest that are not available to the industrial grower.

Farm forestry also has some drawbacks and impediments as compared with large-scale industrial forestry. The long-term approach to land management required for forestry may be a difficult investment for private farmers and landowners to make. Misunderstanding or ignorance of farm forestry in government, planning agencies, funding sources, and the community at large may also be a barrier when beginning a farm forestry project.

Some of the primary advantages and impediments to farm forestry are summarized below.

Relative advantages of farm forestry compared with large-scale industrial forestry
• Site-specific planning and species selection can allow the farm forester to make optimal use of the resources, microclimates, and conditions available on the site.
• Small-scale operations may enable the farm forester to exploit markets for specialty timbers for which there is a small but high-value market.
• More intensive management practices possible on small, private projects can enhance premium value and quality of timber produced.
• Farmers can make better economic and/or personal use of the secondary benefits of trees on their property, such as recreation, wildlife habitat/hunting, livestock shelter, aesthetic values, watershed enhancement, etc.
• Farmers have the possibility of processing timber on-farm for specialty value-added enterprises (on-farm milling, furniture making, woodworking, etc.)

Relative impediments to farm forestry compared with large-scale industrial forestry
• Difficulty in securing recognition, support or funding for small-scale or unconventional forestry projects
• Difficulty in accessing practical information about farm forestry techniques and practices
• Lack of local species trials for farm forestry species and planting patterns (mixed plantings, agroforestry systems, specialty hardwoods, etc.)
• Lack of affordable, skilled labor for planting and maintenance
• Constraints to harvesting and marketing relatively small quantities of wood products

Financial Evaluation

The decision to invest in a farm forestry project involves many issues for private landowners. The potential benefits, drawbacks, costs, and returns of the project must be considered carefully. As with any investment, there are personal as well as business concerns that should be taken into account.

Financial benefits	Personal benefits	Environmental benefits
Timber products Nontimber products Investment opportunity Income tax benefits Property tax benefits Investment tax credit	Reforestation as a community resource Leave a legacy for future generations Improve esthetics of property Recreational Uses	Climate enhancement Species diversity Native species habitat Watershed protection Wildlife habitat Soil stabilization Carbon sequestration

A forestry project also impacts the local community and environment. Forests are among the most highly valued community resources, yet it is difficult to economically quantify all important values of a forest. Intangible values such as aesthetics, habitat creation, shelter, erosion control, etc. are difficult to evaluate financially. They are generally left out of an financial analysis. Therefore, the total value of a farm forestry project may be higher to the farmer than the value shown in the bottom line of the analysis.

Why Financial Evaluation for Farm Forestry?

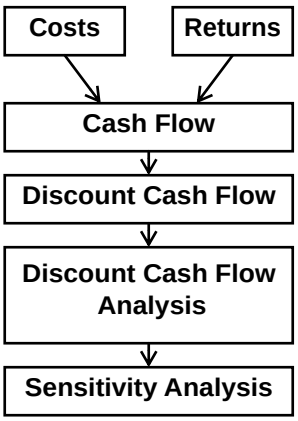
Although there are many personal and environmental factors involved in evaluating a forestry project, financial factors are essential. The landowner has a certain area to plant, with a limited budget. The costs and returns of investing in farm forestry must be weighed against the landowner's other options for economic use of the property. The objectives of the evaluation are to:

- Calculate estimated costs and returns of a farm forestry project.
- Determine the cash flow of a project—when cash will be spent and when returns are expected.
- Understand the basics of Discount Cash Flow Analysis for farm forestry, including the limitations of this approach.
- Quantify some of the perceived risks (financial, market, social, and environmental) involved in a farm forestry project.
- Estimate how profitable the farm forestry project will be so that it can be evaluated relative to other investments, leading to an informed decision.
- Weigh the financial returns against other intangible returns such as aesthetics, wildlife, and erosion control.

Financial Analysis for Farm Forestry

Because farm forestry is a long term investment of land, labor, and resources, it is important that the landowner carefully consider the economic prospects of the practice before investing. Financial analysis tools provide an objective means to compare farm forestry with other uses of resources. Analysis tools can also aid in project design, in selecting project size, implementation factors, schedule, and management strategies. In this sense, the financial analysis works as a decision making tool and is a very important part of the planning process.

Basic Steps for Forestry Financial Analysis



The analysis begins with a projection of expected yearly costs and returns over the life of the project. By subtracting costs from returns, a cash flow is calculated for the life of the project. Usually the cash flow is negative during the implementation and growth stage of a farm forestry project, and becomes positive when harvesting commences.

Because the analysis includes costs and returns projected many years or decades into the future, any financial analysis requires a means to account for the value of money over time. A process called “discounting” is used to reduce a future sum by a certain amount depending on the time at which the future sum is realized—the longer the time delay before a future sum is realized, the more that sum is discounted for the analysis.

A commonly used approach to weighing the costs and returns over the life of a forestry project is through Discount Cash Flow (DCF) analysis. DCF analysis compares alternative courses of action rather than providing an absolute measure of the outcome. In other words, DCF aids in comparing the alternatives to the farm forestry project in order to effectively allocate resources or determine the relative worth of a project. DCF can be an important decision making tool.

Throughout this guide, a hypothetical farm forestry project will be used to illustrate the economic analysis. The Holua Family is considering converting 20 acres of degraded pasture forest. Here is a brief description of the Holua Farm:

Holua Farm Example

Site Characteristics

Characteristic	Description
Property size	20 acres
Property zoning	Agricultural
Access	Hawaii Belt Road
Topography	Uneven flat to sloping
Slope	0-15%
Elevation	Approx. 2300-2500 ft
Rainfall	60-70 inches per year
Average temperature	76°F day, 62°F night
Dry season	October—February
Gulches/draws	None
History of uses	Pasture for at least 40 years
Present description	Recent pasture, certain areas recently cleared
Existing vegetation	Christmas berry, silky oak, jacaranda, ohia-lehua
Soil condition	Rocky, nutrient status unknown
Aspect	West
Water resources	None, natural rainfall only
Timber resources	Some silky oak, jacaranda, ohia lehua
Historic/cultural resources	None known
Wildlife	Exotic birds
Threatened/endangered species	None known
Recreation/aesthetic values	Scattered untouched areas of older trees

Holua Farm Example

Preliminary Design Elements

Holua Farm is an appropriate site to plant koa, the best known native wood of Hawaii. The owners have hired a forestry resource consultant to advise them in their plans. Many of the economic projections for koa are based on studies carried out by the Hawaii State Department of Forestry and Wildlife, the University of Hawaii, and the County of Hawaii. (Loudat et al 1996).

Holua Farm preliminary design elements

Area: 20 acres
Species considered: Koa ((*Acacia koa*)
Spacing: 6 ft X 9 ft (may not be appropriate for koa in all situations)
Initial tree density: 807 trees/acre
Final tree density after thinning: 100 trees/acre (spacing of 24 ft X 18 ft)

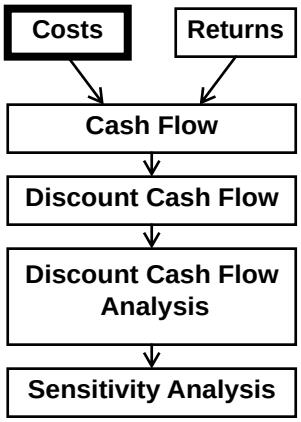
Determining Costs

The first step in the financial analysis is to estimate development costs of forestry. Determining costs can be difficult and uncertain. The following section serves as a guide to costs normally associated with a farm forestry project. Actual costs vary widely depending on local conditions. For the analysis, all values are based on 1999 prices which are held constant throughout the term of the analysis. For consistency, this guide uses costs per acre where possible.

Example distributions of farm forestry costs (typical, Hawaii)

Reforestation costs	Former sugarcane land, Kauai project (% of total)	Rough lava flow, Kona Project (% of total)
Management Plan	1.4	1.3
Site preparation	16.6	26.0
Fencing	0.0	2.9
Fertilizers	8.2	9.5
Tree seedlings	16.6	26.7
Planting	8.6	6.1
Early maintenance (years 1-4)	48.5	27.4
Total	100.0	100.0

Major cost categories



Management Plan

A Management Plan includes fundamental elements necessary for successful implementation including a site environmental assessment (present and historical), site maps, species selections, spacing, scheduling as well as implementation and maintenance strategies. A plan also includes projections for harvesting and marketing of forest products.

In most cases the plan is written in close cooperation with a forestry professional. An experienced farmer may develop their own plan with considerable training regarding the technical aspects of forestry. Professional assistance can be obtained through state, federal or private foresters. Because the landowner will carry out the project over the course of many years, it is essential that the landowner be involved in every phase of the planning process. The Plan should coordinate with a soil and water conservation plan (usually prepared by the NRCS or other conservation extension services), as well as other community projects to enhance watershed and environment (county plan, nature conservation plans, etc.). An important part of the management plan is to fully assess and minimize uncertainty factors such as natural threats and market risks (see Risk assessment). Management Plans should be updated periodically by the owner or hired professional so that adjustments can be made.

Elements of a Forest Management Plan
Site evaluation
Environmental assessment
Maps (topographic, boundaries, etc.)
Photos (site condition, aerial, etc.)
Forestry planning
Species selection and spacing
Nontimber forest products
Installation procedure
Maintenance
Thinning of stands
Harvest plan
Marketing
Time line for development
Financial
Discount Cash Flow analysis
Risk (uncertainty) factors

Site preparation

Site preparation involves clearing the land for reforestation activities. Costs for preparation vary greatly depending on the condition of the site. Pasture is often the least expensive to prepare for forestry, while rough broken land such as a lava flow can be very expensive. Sites with dense, woody vegetative cover can also be costly to prepare. Land formerly used for sugarcane or other industrial crops may require clearing as well as ripping with a bulldozer in order to break through compacted soil layers.

Fertilizers

Fertilizers are often used to enhance forest tree growth in early years. Although fertilizers can be expensive, they are usually worth the investment, since they can substantially shorten rotation length.

Tree seedlings

Seedlings may be purchased from private or state sources, and range in price depending on species and quantity grown. The landowner may also choose to grow their own seedlings, although the costs of establishing and operating a nurs-

ery should be assessed to make sure it is economical when compared to the cost of purchased seedlings. Usually the number of seedlings is in the range of 400-800 per acre (1000-2000 per hectare).

Planting costs

Planting costs include marking planting spots out with stakes and flagging where necessary to facilitate maintenance operations, and planting the seedlings. In farm forestry, planting is usually carried out by hand.

Labor costs

Some landowners may be tempted to dismiss the cost of labor if their own or family labor is used. For the analysis, it is important to calculate the amount of labor required on a yearly basis in order to give meaningful results. An average reasonable labor cost should be selected (e.g. $12/hour) for landowner, family, and hired labor.

Early maintenance

Early maintenance includes weed and pest control as well as other maintenance which facilitates early establishment of the trees. A large part of early maintenance is to reduce weed competition. It is a common mistake to underestimate the costs of maintenance during the first 3-5 years, which usually amount to 50% or more of costs during the early stages of development.

Long-term maintenance

Long-term maintenance includes weed and pest control, brush removal for control of fire, and to clear access roads, fence repair, and so on. Access ways and fences may need to be replaced or rebuilt every 20-30 years. As is often the case with early maintenance, underestimating the cost of long-term maintenance is a common miscalculation.

Pruning

Pruning is used to improve the form of trees by removing lower branches or multiple stems in order to optimize timber production and quality. The result of pruning is to produce a straight stem at least 20 feet (6.5 meters) long, without lateral branches. Pruning is often an economic practice for high-value hardwoods used for high-end markets such as veneer, furniture, etc.

Pruning costs vary with species as some require greater attention. Pruning should be carried out only if the market is available and the costs are more than offset by increased income.

Thinning

Forest stands are usually planted with 4-7 times the number of trees expected at maturity. A process of thinning of the stand usually removes inferior trees, giving the best trees space to grow. Generally it takes 10-15 minutes to thin out surrounding trees in order to produce one sawlog.

Harvesting

Often trees are sold standing. The value of a given area of uncut timber is often referred to as *stumpage*. Harvesting may be part of the plan if timber products will be sold, milled or otherwise processed, or are intended for use on the farm. Harvest costs are influenced by the scale of the project, log size, access, and many other factors. Harvesting costs should be carefully considered in relationship to the intended market or end use of the timber. Harvesting and other value-added processing can dramatically increase project revenues, but will also increase costs and risks. Harvesting is a dangerous operation and safety issues should be considered. Therefore, many landowners opt to hire professionals for harvesting.

Land costs

Usually land costs are not included in the projected costs of reforestation projects as it is assumed that landowner already owns land for the farm forestry project. However, changes in property tax evaluations may affect the economics of reforestation and are usually taken into consideration when evaluating costs and benefits. If land needs to be purchased or leased for the project this cost can be included as a cost at the start of the project and offset at the end by setting a sale price for the land or lease.

Some costs in farm forestry (typical, Hawaii)

Operation	Year	Comments	Approximate Cost
Management plan	0		$2,000–10,000 per project
Site preparation	0	Pasture Scrub (to clear) Rough terrain	$100/acre $300/acre $700/acre
Fencing	0	5-strand barbed wire	$3.00–8.00 per foot, installed
Planting	0	Actual plants Plants/acre Planting	$0.25–$1.50 per plant $200–$800/acre $120–$200/acre
Fertilizing	0–4	Wide spaced Densely spaced	$100/acre $130–$200/acre
Pest control	0,1		$0–$200/acre
Weed control	0–4	Wide spaced Densely spaced	$150/acre $100–$200/acre
Pruning	2 4 5 6	Form Pruning Pruning 0–2 meters Pruning 2–4 meters Pruning 4–6 meters	$0.50/tree (1 minute/tree) $1.00/tree (3 minutes/tree) $1.50/tree (4 minutes/tree) $1.50/tree (6 minutes/tree)
Noncommercial thinning	4 –10		$85/acre
Maintenance	Annual		$100/acre

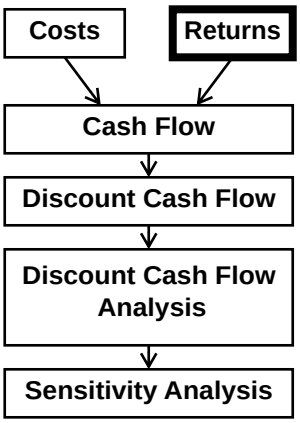
Typically a farm forest in the Hawaiian Islands will cost between $1000 and $2,500/acre to establish, with a further $1,500 to $3,500/acre required for silvicultural work and maintenance during the life of the farm forest.

Holua Farm Example

Anticipated Costs

Operation	Year	Comments	Cost
Management Plan	0	By professional	$60/acre ($2400 for 20 acres)
Site preparation	0	Pasture	$120/acre
Fencing	0	Hog wire	$7.00 per foot, $250/acre
Planting	0	Actual plants Plants/acre Planting	$1.00 per plant $807/acre $200/acre
Fertilizing	0 - 4	Densely spaced	$150/acre
Pest Control	0 & 1		$100/acre
Weed Control	0 - 4	Densely spaced	$150/acre
Pruning	2 4 6	Form Pruning Pruning 0–2 meters Pruning 2–6 meters	$0.20/tree (1 minute/tree) $0.20/tree (1 minutes/tree) $0.60/tree (3 minutes/tree)
Noncommercial Thinning	5, 10		$150/acre
General Maintenance	Annual		$100/acre

Estimating Returns



After estimating costs of the project, the next step is to estimate returns. In Pacific Islands, harvesting, processing, and marketing are other areas where little is known of the critical factors influencing the economics of forestry for small land holders. Predicting growth rates, timber volumes, prices, and markets in 20 or more years is difficult. Farm forestry involves financial questions that economists, researchers, government officials, and scientists cannot presently answer with any degree of certainty. Consequently there is a great deal of economic risk involved in new plantings.

Estimating returns from farm forestry is also difficult due to diverse environmental conditions, soils, management techniques, and species selection. On degraded lands where environmental conditions have become inhospitable to many species. In such areas, the growth and yields even from well-known plantation forestry species are uncertain. Here are some general guidelines for estimating timber returns:

Expected yields for a particular site:

- Trees that are already growing near the proposed site give an indication of future tree growth for species with similar environmental requirements.
- A survey of state forestry and extension agents as well as any trials that have been conducted in the area, can give a landowner an indication of the rate of growth for many species.
- The Natural Resources Conservation Service (NRCS) publishes rough estimates for productivity based on soil class.

Expected yields for a particular species:

- For certain species, long-term trials have been conducted by Government agencies.
- State foresters and some farmers may have experience with many species and can be a rich source of information.
- International trials have been conducted for many commercial species (teak, mahoganies, eucalyptus, etc.) and certain data from similar climates can be translated to estimate local production.

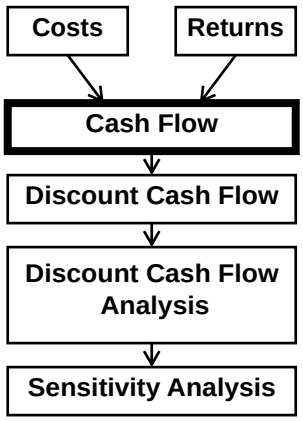
Holua Farm Example

Anticipated returns

It is assumed that the koa trees will be harvested when a diameter at breast height (at 4.5 ft) of 25” is achieved. This diameter is expected to be achieved in year 30, with 1/5 of the trees harvested incrementally over the next 5 years. Trees are expected to have trunk clear of branches to 22.5 ft, with a minimum saleable volume of wood per tree of 450 bf. Each acre will have 46 trees for harvest, 20% of which will be harvested each year during Years 30-34. It is assumed that the trees are sold on the stump to a mill at the price of $3.00/bf (present day dollars). (Grace 1995, Loudat et al 1996)

Note: Yield estimates for koa will vary greatly from site to site depending on rainfall, soils, management techniques and many other factors.

Farm Forestry Cash Flow

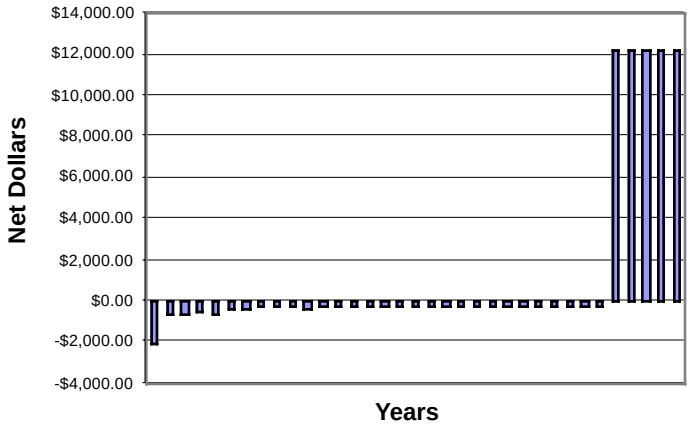


Using annual estimated costs and returns, the cash flow (net payment or income) of the farm forestry project can be calculated. The estimated cash flow indicates when payments will be due and when returns are likely over the life of the trees. The cash flow of the project provides a clear picture of future financial commitments.

Note: All figures are in present (current) day dollars. Figures should be given consistently on a $/acre (or $/hectare) basis.

Once individual year costs and returns have been entered, the costs and returns for each year need to be added to provide a total cost and a total return for that year. Then subtract the yearly costs from the yearly returns to provide a net cash flow.

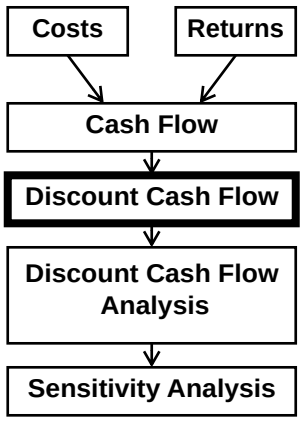
Holua Farm Example



Holua Farm costs, returns and net cash flow (depicted in bar graph above)

Year	0	1	2	3	4	5	6	7	8	9
costs	$2,037	$600	$661	$500	$661	$350	$440	$200	$200	$200
returns	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
net	($2,037)	($600)	($661)	($500)	($661)	($350)	($440)	($200)	($200)	($200)
Year	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
costs	$350	$200	$200	$200	$200	$200	$200	$200	$200	$200
returns	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
net	($350)	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)
Year	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
costs	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200
returns	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
net	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)
Year	**30**	**31**	**32**	**33**	**34**					
costs	$200	$200	$200	$200	$200					
returns	$12,420	$12,420	$12,420	$12,420	$12,420					
net	$12,220	$12,220	$12,220	$12,220	$12,220					

Discounted Cash Flow



A cash flow budget provides a picture of the financial viability of the project. Since a future amount of money is worth less today, a technique called discounting (see side bar) is often used to give future costs and returns a *present day* value.

First, a discount rate must be determined for analysis. A discount rate is like an interest rate. For example, if $1,500 is invested today at 7% interest in 25 years time it will be worth $8,141. Conversely, if the timber from a project is projected to be worth $25,000 in 25 years (in present day dollars), by discounting we can estimate how much it is worth in today's dollars ($4,606 using an interest rate of 7%).

Since the analysis uses constant, present day dollars, the discount rate is above the inflation rate, which is also known as a *real rate*. In other words, the discount rate is the real rate of return over inflation.

The discount rate selected for the analysis should be based on the combined factors of expected return and risk—the higher the risk, the higher the associated discount rate. It is only appropriate to select a discount rate applied to investments with the same risk level as the proposed project.

There are two general approaches to setting the discount rate for the purposes of analyzing farm forestry:

1. The cost of borrowing money.

If money for the project can be borrowed at a certain percentage per year, this value can be used as the discount rate. If the calculated return from the farm forestry project is greater than the interest on borrowed money, then the project is financially viable (it has covered its costs and returned a profit to the investor). If however the project cannot return an amount greater than the interest on borrowed money, the project is not financially viable. The drawback of this method is that land and labor may be surplus resources for the landowner, and cannot be compared directly with borrowed funds.

2. The return from alternative investments.

Here the discount rate is selected to reflect the returns that can be achieved from an alternative project. Comparable projects may include an improved pasture program or other forms of agriculture. The bank rate for loans on forestry projects is a good benchmark. One may also compare investment returns from financial instruments such as stocks and bonds and adjust to account for risk.

The value of money over time: *Discount Analysis*

Because forestry and agroforestry practices involve investments over a long time horizon, it is important to compare future costs and benefits in present value terms. One way to evaluate returns over a certain time period is through discounting. Discounting is the reverse of compound interest. A discounted future value is that future sum discounted back to its present value by a selected interest (discount) rate. Discounting gives an idea of whether a forestry investment will surpass or fall short of other investments at a certain discount rate.

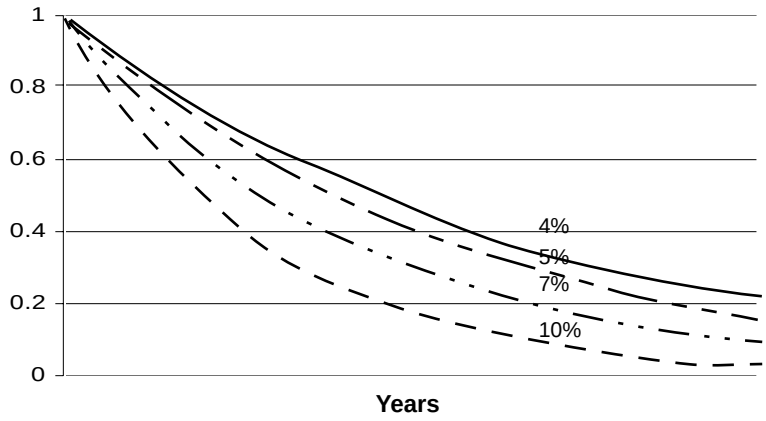
Present Value of Costs and Returns

Once a discount rate has been set for the entire duration of the project until harvest, a *discount factor* can be calculated to discount future sums of money back to today's dollars. The discount factor can be calculated from the equation below:

Discount Factor = $1 / (1 + r)^n$,
where r = Discount rate and n = # years money held

The discount factor decreases rapidly with time, due to the compounding of the discount rate. For example, using a 7% interest rate the discount factor is 51% of the value in 10 years, 26% after 20 years and 13% after 30 years.

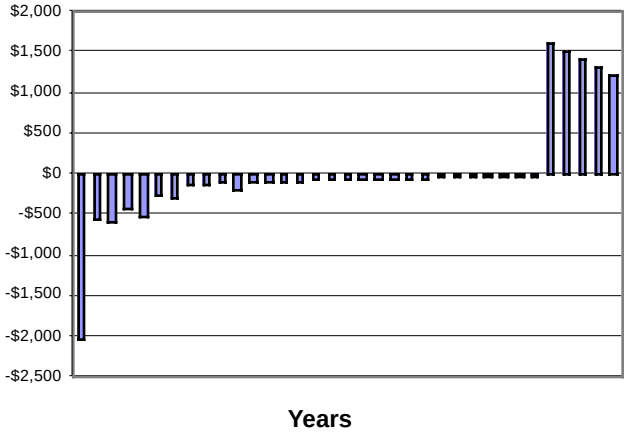
Discount factor comparison for different interest rates.



Once a discount factor has been calculated for a particular year, this is multiplied by the cash flow for that year to provide a *present value* for that return or loss.

Holua Farm Example

Discounted cash flow (at 7%, net per acre)

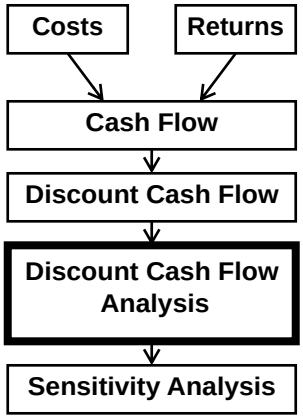


Holua Farm net and discounted net (at 7%) cash flow (depicted in bar graph above)

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
net	($2,037)	($600)	($661)	($500)	($661)	($350)	($440)	($200)	($200)	($200)
discounted net	($2,037)	($561)	($578)	($408)	($505)	($250)	($293)	($125)	($116)	($109)
Year	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
net	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)
discounted net	($95)	($89)	($83)	($78)	($72)	($68)	($63)	($59)	($55)	($95)
Year	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
net	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)	($200)
discounted net	($52)	($48)	($45)	($42)	($39)	($37)	($34)	($32)	($30)	($28)
Year	**30**	**31**	**32**	**33**	**34**					
net	$12,220	$12,220	$12,220	$12,220	$12,220					
discounted net	$1,605	$1,500	$1,402	$1,310	$1,225					

Analysis Tools Using Discounted Cash Flow (DCF)

Relative returns of farm forestry



Discount cash flow (DCF) analysis allows comparison with returns from alternative projects e.g. buying new equipment, pasture improvement or expansion, buying more land, continuing with agriculture or, for that matter, investing in the stock market.

Most farm forestry analyses consider agriculture as the benchmark against which a farm forestry project is to be compared, asking in effect, "Is farm forestry a more profitable use of this land than agriculture?" Present or anticipated earnings from agricultural use of the land can be compared against a farm forestry project.

Some guidelines of DCF:

- DCF is based on the premise that money today is worth more than the same sum of money in the future, because money can be invested today to produce a greater sum of money in the future.
- Because of the difficulty in predicting long term effects of inflation on costs and prices, inflation is often ignored (which is the same as assuming all costs and returns will inflate at the same rate over time). Therefore all future sums used in the economic analysis are **real**, present day dollars.
- As with any economic analysis, DCF analysis is only as good as the data that goes into it.
- In this guide, to allow for an easy comparison between projects on the farm, all figures are given in present day dollars per acre ($/ac).

Net Present Value

Net Present Value (NPV) is commonly used to evaluate long term forestry investments. Once a discounted cash flow is projected, NPV is very easy to calculate as the sum of discounted cash flows. An investment is considered economically feasible if NPV is equal to or greater than zero at a given discount rate.

NPV provides an estimate of the absolute amount of profit and is very useful in comparing investment options, as long as future benefits, costs and discount rate are estimated accurately. Since estimates are used, rather than exact costs and returns, NPV is usually used as a ranking tool for comparing different options. Risk assessment can be used to determine how sensitive NPV is to variation in these values (see risk assessment below).

Holua Farm Example

Nominal NPV values

Range of NPV's for the project using the nominal cost and return estimates:

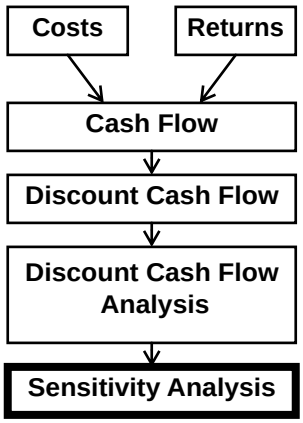
Discount Rate	NPV
4%	$9,734
5%	$6,336
7%	$779
10%	–$2,330

The NPV values are all positive at 7% or less, so the project is expected to exceed an interest rate of 7%. Since the NPV at 10% is negative, the project is not expected to reach a return of 10%.

Sensitivity Analysis

Sensitivity analysis evaluates how changes in estimated variables such as benefits, costs, and discount rates effect the outcome of the analysis. For all of the above measures, sensitivity analysis is recommended. In forestry, estimates of timber yield, quality, and time to harvest, for example, may strongly influence returns. It is important to change some of the key variables by an appropriate amount (e.g., 50% up and down) to get an idea of how sensitive the measure is to various estimates. This allows the grower to compare how "best case" and "worst case" scenarios effect the overall outcome (see Holua Farm example).

Uncertainty Factors



Forestry projects are subject to a wide variety of risks for a longer period of time than most other agricultural activities. Many natural risk factors are site specific (e.g., flooding, landslide, lava flow, etc.) whereas others are more widespread (e.g., hurricane, earthquake, etc.). Forestry also faces a wide variety of other environmental threats, including those that may be induced by humans such as fire and pest introductions. Future markets for timber products are also uncertain as new manufactured replacement products are developed.

Risk factors should be accounted for in the financial analysis. One method to include risk into Discount Cash Flow analysis is to use an increased discount rate, which reflects the added yearly risk of a forestry investment. The increased discount factor can be determined by analyzing historical data in relation to natural, human, and social factors for a particular site. Another method to analyze risk is to use sensitivity analysis to adjust cost and benefits in the calculations to evaluate a variety of best and worst case scenarios.

Some Risk Factors

Natural disasters	Human influence	Social factors	Economic uncertainties
Hurricane Flood Drought Lava flow Earthquake Landslide	New pests/ diseases Species choice Management decisions Fire	Harvest laws Tax laws Cultural values Community pressures	Inflation Wood quality Replacement products Demand

Risk can be incorporated by varying certain key estimates, such as:

- Increasing the projected cost of labor;
- Using higher costs if the exact cost of an operation is not adequately known;
- Being conservative with tree growth rates and timber yields;
- Being conservative with wood prices;
- Using a higher discount rate in the analysis to reflect a greater conservatism in the use of money;
- Adding the costs of insurance; and
- Adding the costs of protective practices such as windbreaks, fire breaks, erosion control, etc.

The aim of sensitivity analysis is to identify the key factors that effect outcome, and focuses the analysis on them. Sensitivity analysis by varying key factors one at a time can help gauge risk. For example, varying yields, costs, or time to harvest can show how these factors effect outcome. In real world situations, however, many key factors can vary simultaneously. Analysis involving simultaneous changes is desirable, but may be difficult to carry out by some landowners. These landowners may consider seeking the assistance of forestry professionals in the analysis.

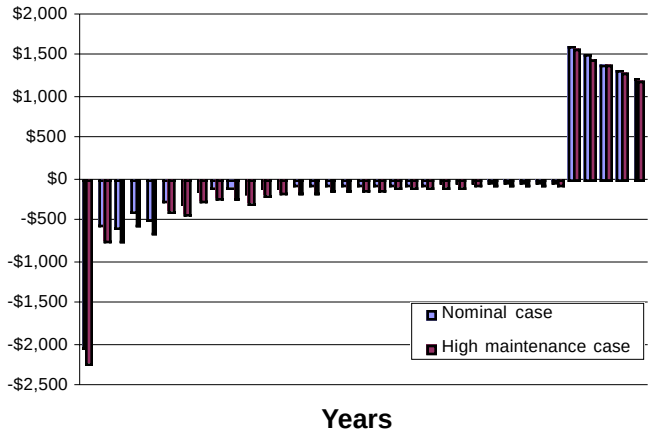
Holua Farm Example

Risk Factors

Varying certain parameters in the Holua Farm example gives an indication of how unexpected costs or yields will effect the outcome of the analysis.

For example, what if maintenance costs are higher than expected? High maintenance example adds $200 to the maintenance costs each year throughout the 35 year project.

High maintenance case compared with nominal (discounted net 7%)



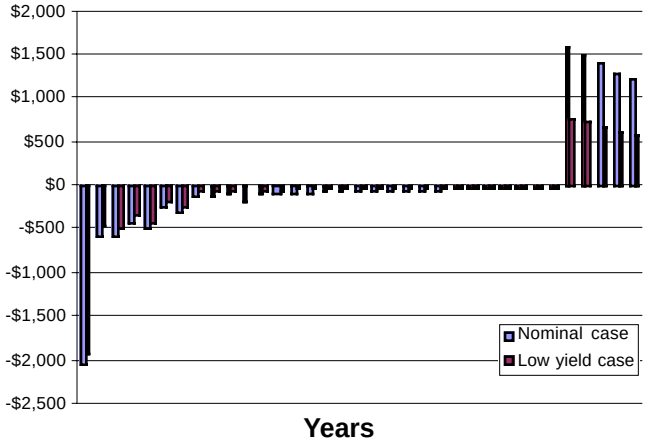
High maintenance cost NPV values

Discount Rate	NPV
4%	$8,030
5%	$4,186
7%	-$397
10%	–$3,206

The project NPV values are positive at 4% and 5% even with the high maintenance costs. The negative NPV at a discount rate of 7% indicates that the project will not reach a 7% return with the high maintenance costs.

Project yields may vary significantly. For example, what if returns are lower than expected by 50%? Such a reduction in yields could be due to lower productivity (disease, drought, hurricane, etc.) or to a price collapse for certain timbers.

Low returns compared with nominal (discounted net 7%)



Low returns NPV values

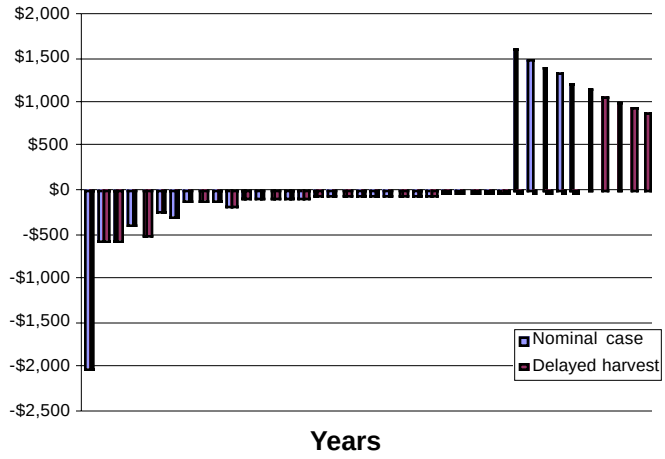
NPV values for the low yield example (half the yield in board feet, or half the price per board foot)

Discount Rate	NPV
4%	$2,965
5%	$1,359
7%	-$1,260
10%	-$2,670

With the half the yield, the NPV values indicate that the project will exceed a return of 5%, but will fall short of a 7% yield.

The time until harvest is uncertain for most species. This example considers the case where the maturity of the trees is delayed by five years.

Delayed harvest compared with nominal (discounted net 7%)



Delayed harvest NPV values

NPV values for the slow growth scenario:

Discount Rate	NPV
4%	$6473
5%	$2827
7%	–$1218
10%	–$3379

With the 5-year harvest delay, the NPV values indicate that the project will exceed a return of 5%, but will fall short of a 7% yield.

Including the Additional Benefits of Trees

Owners of farm forestry projects are uniquely positioned to capture the indirect benefits of forestry such as shade, shelter, erosion control, wildlife habitat, aesthetics, land values, etc. However, it is often difficult to place an objective dollar figure on these additional benefits. As indirect benefits are usually left out of the analysis, the standard analysis techniques described above usually underestimate the financial worth of the forest.

For the purpose of personal decision making, one way to incorporate the indirect benefits of trees into the analysis is for the landowner to subjectively put a dollar value on the benefits. For example, the landowner may put significant value on the recreational value and native wildlife habitat, while other indirect benefits are of little perceived value. The perceived values of the indirect benefits then can be incorporated into the cash flow analysis to help the landowner make a decision. Perceived values vary from person to person; three examples are illustrated below.

Example perceived values

Indirect Benefit $/acre/year	Perceived value Landowner A	Perceived value Landowner B	Perceived value Landowner C
Aesthetics	$50	$25	$50
Legacy	$0	$50	$0
Cultural values	$0	$0	$50
Watershed	$0	$10	$0
Habitat	$40	$20	$10
Erosion Control	$5	$10	$0
Soil improvement	$0	$10	$20
Total indirect benefits	$95	$125	$130

Comparison with Other Land Uses

The costs and benefits of reforestation vary widely, and depend upon site conditions as well as on many factors such as tree spacing, maintenance techniques, and the rate of growth of the trees. In general terms, the initial investment costs for reforestation are comparable to those of establishing a fruit orchard. Unlike orchards, reforestation project maintenance tapers off to a low level after 4-6 years, whereas orchards require steady and intensive maintenance. However, forestry involves a considerably longer time before timber is harvested and sold. Here is a cost comparison for different land uses:

Land Use	Establishment Costs	Maintenance Costs
Pasture	Low	Low
Reforestation	Medium	Low to Medium
Orchard	Medium	High
Nursery	High	Very high
Landscaping	High to Very high	High to Very high

To compare a farm forestry project with agriculture, the same process of analysis should be done for both. Starting with yearly costs, benefits, risks and uncertainties for each alternative practice, discount cash flows can be calculated. Ensure that comparable costs such as labor, materials, lease rent, discount rates, etc. are the same in all analyses. Then DCF analysis can be carried out for both. Using these analysis tools, different alternatives can be compared. For example, if the agricultural NPV is greater than the farm forestry project at the same discount rate over the same period of time, agriculture is the more profitable venture. If farm forestry has a higher NPV, farm forestry is more profitable.

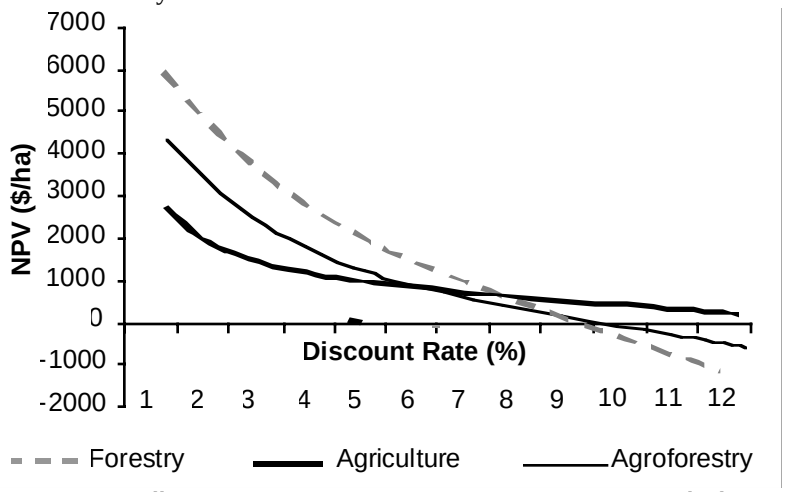
Other Considerations

In addition to DCF analysis there are other important considerations when comparing the financial viability of two options such as farm forestry and agriculture.

- Agriculture may not be as profitable, but the returns are annual. Farm forestry has large costs early in the project, with positive returns occurring many years in the future.
- Labor requirements for the farm forestry project will be high during the planting, early maintenance, pruning, and harvesting, while after establishment there are long periods where little labor is required.
- Agricultural markets are relatively well known in the short term. Farm forestry markets are more uncertain due to the relatively long time horizon until harvest.
- Most farmers have the skills and confidence for agricultural production. New skills and technologies may have to be learned and understood to successfully carry out a commercial farm forestry product.

The Effect of the Discount Rate

The discount rate used has a large effect on whether agriculture or the farm forestry project will be more profitable. Because agriculture generally has early annual returns, agriculture is comparatively more profitable when higher discount rates are used. Because forestry has large returns at the end of the project, using a lower discount rate will show the farm forestry project to be comparatively more profitable as the large return at the end of the project is not discounted as heavily.



(Source: Australian Master TreeGrower Farm Forestry Economics)

Improving the Economic Picture

The techniques outlined in this guide enable the landowner to get a basic idea of the "bottom line" of their project. Beyond proper planning, species selection, and management of their project, there are a number of things landowners can do to improve the economic picture.

The returns from the timber product can be increased by using value-added strategies, and by market positioning. Overall returns can be changed and improved by the incorporation of agroforestry strategies that provide diverse products and earlier yields until the timber trees are ready for harvest. Many of these strategies can enhance the economic benefits of the project dramatically. This section introduces some of these important strategies. As returns increase along the value chain, so do the costs of production. When considering value-added strategies the final outcome should be considered in terms of profits realized.

Timber Products: Value Added Strategies

The economic analysis techniques outlined above are usually used to predict costs and returns based on selling timber trees standing in the field ("on the stump"). However, selling timber on the stump is selling it at its lowest value, as a raw material. For a smaller-scale planting, the return at this point is often low. Anything a landowner does to elevate their product from a raw material prior to selling adds value to their product. This may improve the economic benefits of the project.

Adding value increases the perceived worth of a product, and thus the market price. Adding value can be accomplished in many ways. Value-added strategies may involve minimal processing, or practices that require advanced processing.

Value may also be added even to raw or minimally processed products by improving the reputation or name-recognition of the timber, which allows the seller to charge a premium for the product.

Adding value to timber products usually demands a higher investment of time, education, skills, resources, and equipment than selling on the stump. Some landowners may decide to sell their timber on the stump for the sake of convenience. For many landowners involved in small-scale forestry, the investments in value-added processes are part of the pleasure of owning and caring for a forest. Moreover, the investments may pay off handsomely in the form of much higher returns as compared with selling trees standing in the field. In any case, securing markets for raw or value-added products is essential for the financial success of the project.

Increase price for value added processing (*Acacia koa*)	
on the stump	$1–3 per board foot
whole logs (harvested and delivered)	$2–6 per board foot
milled lumber	$4–30 per board foot
finished koa product (furniture)	$10–200 per board foot

Processing—harvest, drying, milling (especially small-scale technologies)

Tree felling, debarking, hauling, drying, and milling are all part of timber processing. Each of these processing steps requires skill and experience, and usually requires heavy equipment adapted to handling large logs. Depending on the size of the project, it may be a wise investment to purchase or lease such equipment, and even hire or train equipment operators. Generally, the larger the project, the better the returns on heavy equipment.

For smaller projects, there are a range of small-scale mills available that allow quality milling to be done in the field at low cost. Such mills reduce the costs of transporting large logs, while greatly reducing equipment costs and disturbance to the forest.

Certification of sustainably harvested woods

Certification of sustainable woods has become a means to ensure customers that certified wood products are harvested and processed in accordance with certain environmentally friendly practices. Certification programs for sustainable forestry are relatively new and therefore customer demand and the future market value for certified wood products is uncertain. Currently, buyers in the European market and some in the USA are willing to pay a premium of about 10 to 15% for woods that were harvested sustainably. However, the costs for the private landowner to participate in a certification program can also be high.

Name recognition

Developing name recognition is the process of distinguishing a product from other products, so that it can easily be communicated and marketed. The process is similar to creating brand-names. Usually a brand is a business name whose reputation is associated with product quality. For timber products, a similar principle of branding can be used by identifying the place woods are grown as special, and/or by popularizing a type of wood or species of wood. An example is "Hawaiian koa," (*Acacia koa*) and which is associated with high quality wood and products. Unknown woods with similar or superior quality to koa and monkeypod may become much more marketable and command a higher price when name recognition is used to distinguish them from other woods.

Specialized markets

Specialized or "niche" markets are certain individuals, groups or product outlets with unique, specialized or uncommon product needs. Hawaiian crafts people, model airplane manufacturers and cabinet makers are all examples of potential specialized markets. Targeting a specialized market in the early stages of the project, even before the trees are planted, can lead to greatly increased returns.

Reducing risks through crop insurance

Risk management in agriculture is aimed at attaining a desirable combination of income and risk exposure. Some producers want to obtain the highest possible return and are willing to accept the risks involved. Others may seek to minimize their risks and accept a lower return.

The Federal Crop Insurance Corporation (FCIC) is considering expanding the number of crops insured in Hawaii and a policy for timber will be considered. The FCIC will only offer a policy if the growers are interested. Crop insurance is a method of reducing the risk of farm forestry. There are two basic types of crop insurance: single risk (e.g. wind) and yield-based, which insures against multiple risks (e.g. wind, fire, disease).

Federal subsidization of crop insurance allows growers to obtain significant risk reduction at a relatively low cost. In total, growers have received more in insurance loss payments than they have paid in premiums, meaning that many have not sacrificed income over the long term to lower their risk exposure. If offered, growers engaged in farm forestry should consider crop insurance as a risk management tool.

Agroforestry to Improve Economic Benefits

Aside from improving the value of the timber product, there are also a number of strategies that can improve the overall returns from a farm forestry project. Because of closer landowner involvement, small-scale forestry is uniquely suited to incorporate nontimber yields which can increase the economic benefits.

Integrating tree crops with other crops or animals is known as agroforestry. The nontimber crops may include short-term crops that are phased out as the forest matures, or permanent production systems of crops, animals, and/or multiple use plants that provide sustained yields for many years.

Here are some of the ways agroforestry can improve returns over forestry alone:

Earlier returns

An advantage of agroforestry is the possibility of early yields from nontimber crops such as herbs, medicinals, fruits, or other crops that are interplanted with the timber trees. By producing returns early in the project, nontimber yields can pay back investment costs earlier than timber yields, which can enhance the economics of the project as a whole.

More efficient use of space

In non-agroforestry plantings, the space between trees must be mowed or maintained, which is a large expense. Using that space for a crop instead may take a similar amount of effort to maintain, but will also provide a return.

Added ecosystem diversity

Generally, the more species included in a system, the lower the risk of devastating problems caused by one pest or disease.

Added economic flexibility

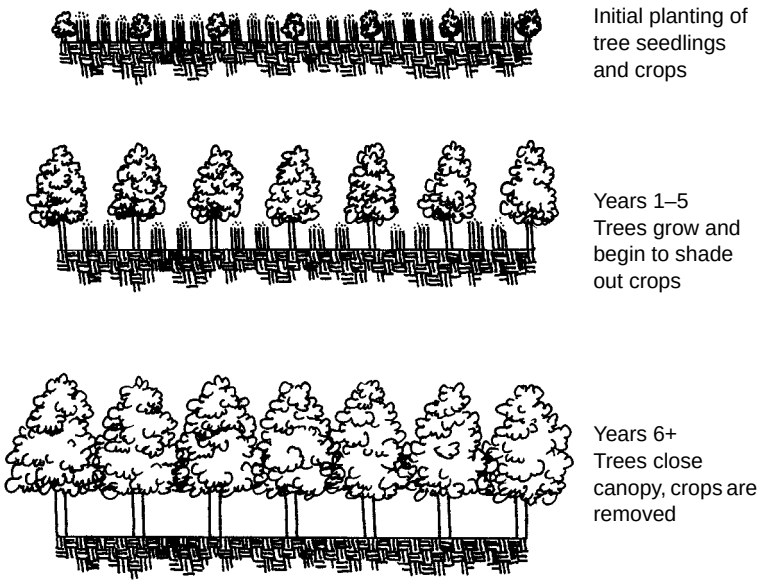
Multiple products give the landowner the option to sell products that will give the best overall return in a given year. Product lines can change from year to year based on demand and market conditions.

This section introduces some of the promising systems for improving the economic benefits of forestry, from short-term nontimber yields, to sustained nontimber yields, and other forest sources of revenue.

Short-term Nontimber Yields (Sequential Cropping Systems)

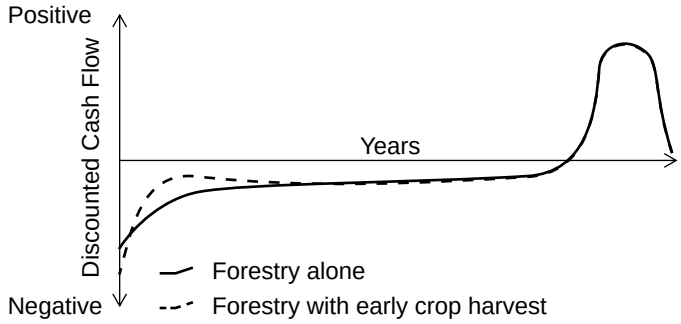
While forest seedlings are still small, there is considerable open space between them that can be used to grow short-term agricultural crops. By growing such crops during the first 2-4 years, the cost of weed control and other maintenance for the forest seedlings can be reduced. Income from these crops can help to offset part of the cost of installing the forest. This is called “sequential planting,” a practice wherein short-term crops are planted with, and eventually replaced by,

long-term trees. Sequential planting can be a viable system for farmers or forest planters who need a short-term return as they invest in long-term tree crops.



Generic sequential cropping system

Many combinations of crops and trees have been combined in this kind of system, with crops including rice, corn, beans, root crops, vegetables, fruits, ornamental flowers or foliage, and other cash or subsistence crops (Nair 1993). In Pacific Island settings, sequential crops planted between forestry trees have included sweet potatoes, cassava, yam, kava, pineapple, papaya, and cardamom (Clarke and Thaman 1993). For farmers considering a sequential cropping system, understanding the growth, rooting habits, and the tree/crop interactions is important, to ensure plants will be compatible and not overly competitive in the short-term.



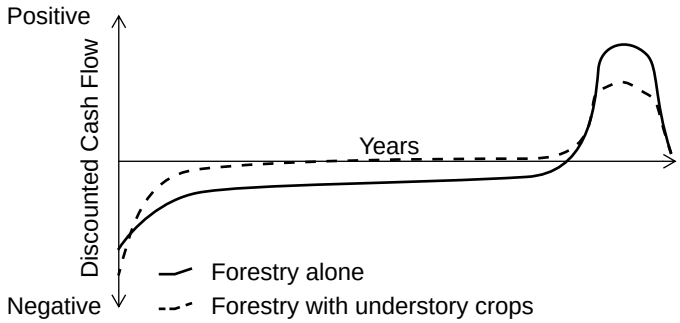
Theoretical effects of sequential cropping on cash flow.

There are several advantages to sequential plantings in forestry, including:

- greater efficiency in land use (less land area is fallow while tree crops mature);
- increased efficiency in labor (because crop maintenance can overlap);
- increased total yields; and
- long-term investment made more economically viable through short-term yields.

Sustained Nontimber Yields

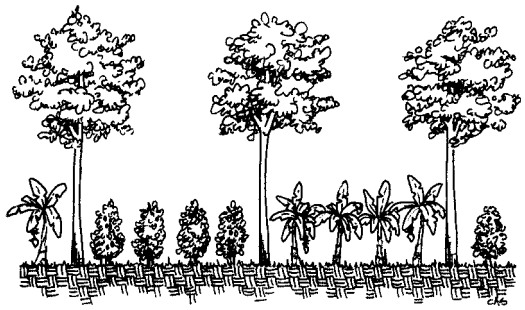
While sequential crops are phased out as the forest matures, there are a number of agroforestry practices that are permanent components of the forestry system. These include shade-loving crops grown under the forest trees, animals integrated with the forest trees, or nontimber products such as fruit and seeds. These supplementary products can provide sustained sources of income for many years over the life of the project. Unlike sequential cropping, many of these systems have fewer forestry trees per acre, and therefore lower timber yields, than a pure stand of forestry trees. However, the earlier, sustained yields from nontimber products makes this practice economically attractive to many landowners. In addition, landowners who integrate long-term nontimber yields with their forestry planting have the advantage of a diversified cropping system, which lowers the risk of total loss in the event of environmental or market conditions that may affect a single kind of crop. Some examples of sustained nontimber yields follow.



Theoretical effects of nontimber yields on cash flow

Understory crops

Understory crops are grown in the shady environment under the timber trees. Unlike sequential crops, understory crops are installed and managed to produce for many years as the forest matures. Usually the number of timber trees per acre is 25-75% less than when timber trees are planted alone, to make space for the understory crops.



Understory crop examples: banana and coffee under timber trees

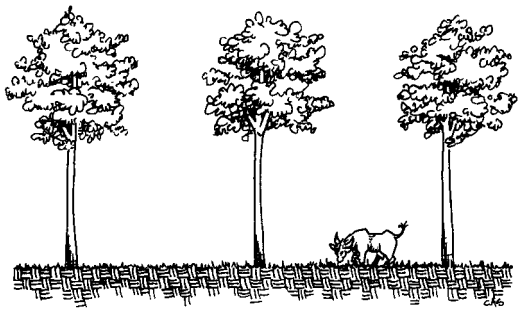
There are many valuable cash and subsistence crops that thrive in the shady climate under trees. Plantings that take advantage of the understory range from simple systems consisting of one species in the overstory and one in the understory, to complex systems with many layers of trees, shrubs, and herbaceous plants stacked together as appropriate for their needs.

Examples of understory crops that can be integrated with forestry include trees crops like coffee, cacao, guava, and Annona species; essential oils such as patchouli and vetiver; spices such as pepper vine, ginger, vanilla, and turmeric;

root crops, herbs, pineapple, tea, kava, ornamental flowers and foliage, and mushrooms. Some traditional cultural plants such as for garlands (leis), crafts, or medicinal uses may also be adapted to the understory environment.

Silvopastoral Systems (Timber Trees and Livestock)

When planned properly, grazing livestock can be integrated with certain tree species. In this scenario, the livestock play two roles. First, the animals are a source of income. Second, the grazing livestock provides economical control of weeds and brush with minimal use of herbicides or mowing. In silvopasture, the interactions among timber, forage and livestock are managed intensively to simultaneously produce timber commodities, a high quality forage resource and efficient livestock production. For silvopastoral systems, timber species are usually spaced wider than standard to optimize healthy pasture forage underneath. Potential livestock choices include cattle, sheep, goats, horses, turkeys, and chickens.

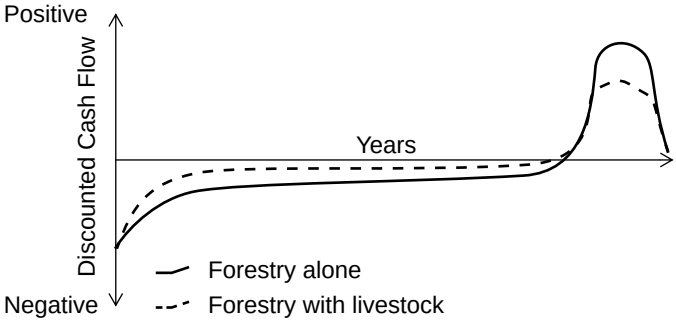


Silvopasture Example: Cattle under timber trees

Silvopasture can provide a relatively constant income from livestock sale (Klopfenstein et al 1997). At the same time, the economic risk of the project is reduced because the system yields multiple products. Also, production costs are reduced by distributing management costs between timber and livestock components (Klopfenstein et al 1997).

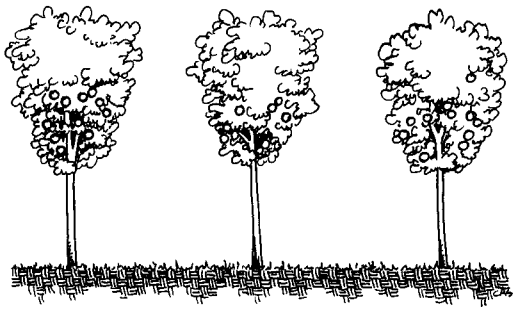
A successful silvopasture requires understanding forage growth characteristics and managing the timing and duration of grazing to avoid browsing or damage to young tree seedlings. Livestock should be excluded from tree plantings during vulnerable periods.

In the Pacific Islands, the grazing of cattle under commercial timber species has been practiced in many settings. In Papua New Guinea, cattle have been used to control weeds and reduce fire danger under plantations of Caribbean pine (*Pinus caribaea*), hoop pine (*Araucaria spp.*) and *Eucalyptus* species. In Vanuatu, cattle have been grazed under *Cordia alliodora* as well as under *Pinus caribaea* plantations (Clarke and Thaman 1993).



Theoretical effects of silvopasture on cash flow

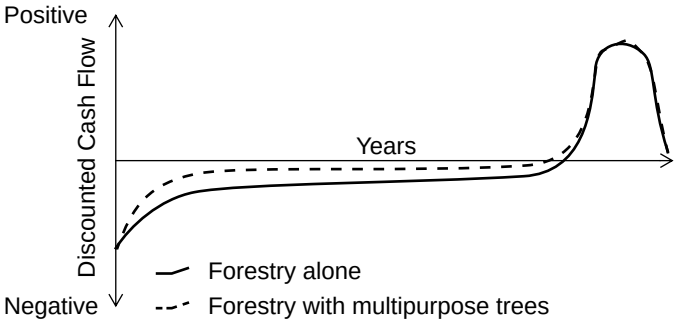
Multipurpose Timber Species



Multipurpose Trees can offer early yields of nontimber products such as fruit, seeds and essential oils.

Some timber trees can provide secondary nontimber products. These can include seeds, fruits, essential oils, medicinal products, resins, flowers, and more. In some cases, harvest of these products can begin after only a few years, and may provide a steady income throughout the life of the project until the trees are harvested for their timber. Planning for multiple uses from the timber trees requires some extra effort in species selection, and may involve balancing the timber yields with the desire for secondary products. For example, planting a forestry project that will also serve as a seed orchard requires that trees be selected not only for their ability to produce timber on the site, but also for their ability to produce viable, genetically rigorous, high-quality offspring, in order to create a marketable seed product. For fruit production, tree varieties that have the highest quality fruit may not have the best growth and form for timber, and the landowner will have to decide how to balance these needs.

Examples of timber trees that have economically viable secondary products include neem (*Azadirachta indica*), a mahogany relative with recognized medicinal and insecticidal properties in the leaf, seeds, and bark; jackfruit (*Artocarpus heterophyllus*), which produces fruit, dyes, and medicinal products; teak (*Tectona grandis*), with many traditional medicinal uses; and mango (*Mangifera indica*), valued for its fruit.



Theoretical effects of multipurpose trees on cash flow

Other nontimber revenue sources from the forest

Aside from selling products from the forest, landowners may also improve the economic return by marketing some of the uses of the forest. Hunting licenses, hiking trails, horseback rides, camping permits, eco-tourism activities, and other recreational uses of the forest can provide substantial revenue to a project over time.

Resources and Recommended Reading

Local Assistance

There are government agents, professional forestry consultants, computer models, and informed neighbors that can assist landowners in determining the appropriateness of forestry in their situation. Professional assistance is usually recommended if the venture to be considered as more than a casual hobby. There is no substitute for direct, locally appropriate assistance.

The Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) provides assistance with conservation practices such as windbreaks and contour plantings. They also have a Forest Incentive Program, to increase the supply of timber products from nonindustrial private forest lands. They have offices throughout the American-affiliated Pacific. To find the one nearest you, contact:

NRCS State Office
P.O. Box 50004, Honolulu, HI 96850-0050
Tel: 808-541-2600, Fax: 808-541-1335 or 541-2652
Web site: http://www.hi.nrcs.usda.gov

The Cooperative Extension Service (CES) of the University of Hawaii can assist landowners with further information. There are CES offices throughout the State of Hawaii; to local one near you contact:

Cooperative Extension Service Main Office
3050 Maile Way, Gilmore Hall 203, Honolulu, HI 96822
Tel: 808-956-8397, Fax: 808-956-9105
E-mail: extension@ctahr.hawaii.edu
Web site: http://www2.ctahr.hawaii.edu

The State of Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife provides information, education, and support for forestry. Some cost-sharing and other partnerships with private landowners are available. Contact:

Division of Forestry and Wildlife
1151 Punchbowl St. Room 325, Honolulu, HI 96813-3089
Tel: 808-587-0166, Fax: 808-587-0160
Web site: http://www.hawaii.gov/dlnr/dofaw/

Societies and Organizations

The International Society of Tropical Foresters (ISTF) provides a communication network for tropical and subtropical forestry. Publishes quarterly newsletter ISTF News. Address:

International Society of Tropical Foresters (ISTF)
5400 Grosvenor Lane, Bethesda, Maryland 20814 USA
Tel: 301-897-8720; Fax: 301-897-3690
Web site: http://www.cof.orst.edu/org/istf/

Hawai‘i Forest Industry Association (HFIA) is a community-based nonprofit organization of people interested in managing forests in Hawaii. Publishes the quarterly newsletter Woods: A Newsletter for Forestry and Conservation.

Hawaii Forest Industry Association
P. O. Box 10216, Hilo, Hawaii 96721 USA
Tel: 808-933-9411; Fax: 808-933-9140
Web site: http://www.hawaii-forest.org/

Certification Programs

The Forest Stewardship Council (FSC) is an internationally recognized nonprofit accreditation agency for forest certification programs. FSC promotes responsible forest management by evaluating and accrediting certifiers, by encouraging the development of forest management standards, and by providing information about independent, third-party certification as a tool for ensuring that the world's forests are protected for future generations.

Forest Stewardship Council
1134 29th Street NW, Washington, DC 20007
Tel: 877-372-5646 (toll free); Fax: 202-342-6589
Web site: http://www.fscus.org

Rainforest Alliance SmartWood Program
Goodwin-Baker Building, 61 Millet St., Richmond, VT 05477
Tel: 802-434-5491; Fax: 802-434-3116
Web site: http://www.smartwood.org

Web Links

Australia Master TreeGrower Farm Forestry Economics Exercise includes extensive practical information in forestry planning, management and economics. School of Forestry, The University of Melbourne, Australia. Web site: http://www.mtg.unimelb.edu.au/

Warnell School of Forest Resources site at the University of Georgia's College of Agricultural and Environmental Sciences covers the basics of budgeting for forestry in a temperate setting. Web site: http://www.ces.uga.edu/pubcd/b1032-w.html

USDA Forest Service Southern Region offers the very useful Tax Tips for Forest Landowners, which is updated annually. Web site: http://www.r8web.com/taxtips/

Forest Market Reports, published by the Australian National University, publishes geared to provide information to farm foresters. Department of Forestry, The Australian National University, Canberra ACT 0200, Australia; Fax: +44 2 6249 0746; Web site: http://www.anu.edu.au/Forestry/info/marketreport/index.html

Methods for Estimating Timber Volume of Trees from Auburn University and The Alabama Cooperative Extension. Web site: http://www.aces.edu/department/extcomm/publications/anr/anr-263/anr-263.html

Mississippi State University Extension Service offers a useful forestry planning discussion in Forest Management Alternatives For Private Landowners. Web site: http://ext.msstate.edu/pubs/pub1337.htm

The National Timber Tax Web Site: Tax Management for Timberland Owners helps answer specific questions about the tax treatment of timber in the US. Web site: http://www.fnr.purdue.edu/ttax

Links to Links

The University of Hawaii Forestry Links by the College of Tropical Agriculture and Human Resources presents a wide variety of useful information for Hawaii foresters and tree farmers. Web site: http://www2.ctahr.hawaii.edu/forestry/hawaii_forestry_links.htm

Directory of Forest Products, Wood science, and Marketing contains a large amount of internet information on the forest products industry. Web site: http://www.forestdirectory.com/

About.com hosts and extensive resource for Internet sources regarding many aspects of forestry. Web site: http://forestry.about.com/education/forestry/

Periodicals

Agroforestry News is a periodical published in Australia. It features practical, timely information for farm foresters. Order from: Agroforestry News, NRE Port Phillip Region, Locked Bag 3000, Box Hill 3128 Victoria, Australia. Web site: http://www.linchpin.com.au/Agroforestry_News/

See also Organizations for periodicals from HFIA and ISTF.

Acknowledgments

Significant contributions of material and review were made by Rowan Reid and Peter Stephen, The Australian MasterTreeGrower Program, School of Forestry, The University of Melbourne.

Special thanks are due to the experienced resource professionals who provided valuable review and feedback for this publication including: U.N. Bhati, Economist, ANU Forestry, Canberra, Australia; Richard Bowen, Professor of Economics, University of Hawaii, Manoa, Hawaii; Chris Cousins, Peace Corps Volunteer, Passy, Senegal; Karl Dalla Rosa, Forester, Institute of Pacific Islands Forestry, U.S. Forest Service, Honolulu, Hawaii; Dale Evans, Editor, Publications and Information Office, CTAHR, University of Hawaii, Manoa, Hawaii; J.B. Friday, Assistant Specialist, Tropical Forestry Extension, CTAHR, University of Hawaii at Manoa, Hilo, Hawaii; Braden Jenkin, Forestry Consultant, Victoria, Australia; Kent Lighter, Farmer/Forester, Kohala, Hawaii; Robert Wescom, Agroforester, USDA NRCS, Guam; Ed Winkler, Forester, Winkler Wood Products, Hilo, Hawaii.

The input of all reviewers contributed immensely to this guide. The authors accept full responsibility for any errors or omissions.

About the Authors

Craig R. Elevitch is an agroforestry specialist with more than ten years of public and private sector experience in tropical agroforest and forest management. He has a M.S. degree in Electrical Engineering (Dynamical Systems) from Cornell University.

Kim M. Wilkinson is the Education Director for Permanent Agriculture Resources and editor of The Overstory, an international tropical agroforestry journal. She has B.A. degrees in Anthropology and Ecology from Emory University.

Christi A. Sobel is a freelance scientific illustrator and artist who has been published by the Royal Botanic Gardens, Kew, and Educational Concerns for Hunger Organization (ECHO). She holds a graduate degree in Scientific Illustration from University of California, Santa Cruz.

References

Camp, O. 1984. The Forest Farmer's Handbook—A Guide to Natural Selection Forest Management. Sky River Press, Ashland, Oregon.

Clarke, W.C., and R.R. Thaman. 1993. Agroforestry in the Pacific Islands: Systems for sustainability. United Nations University Press, Tokyo.

Current, D., E. Lutz and S. Scherr, Eds. 1995. Costs, Benefits, and Farmer Adoption of Agroforestry. The World Bank, 1818 H Street, N.W., Washington, DC 20433.

Grace, K.T. 1995. Analysis and Prediction of Growth, Grazing Impacts, and Economic Production of Acacia koa. Doctoral Dissertation, University of Hawaii, Manoa, Hawaii.

Haney, H.L., and J.E., Gunter. 1995. Essentials of Forestry Investment Analysis. Virginia Polytechnic Institute and State University, Blacksburg, VA 24060.

Holmgren, D. 1994. Trees on the Treeless Plains: Revegetation Manual for the Volcanic Landscapes of Central Victoria. Holmgren Design Services, Victoria, Australia.

International Institute of Rural Reconstruction. 1990. Agroforestry Technology Information Kit. IIRR, Room 1270, 475 Riverside Dr., New York, NY 10115.

Klopfenstein, N.B., W.J. Rietveld, R.C. Carman, T.R. Clason, S.H. Sharrow, G. Garrett, and B.E. Anderson. 1997. Silvopasture: An Agroforestry Practice. In Agroforestry Notes, USDA National Agroforestry Center, Lincoln, Nebraska.

Loane, B. 1991. Economic Evaluation of Farm Trees—Methodology and Data for FARMTREE Model. Joint Agroforestry Management Committee of Victorian Government, Department of Agriculture and Department of Conservation and Environment, Victoria, Australia.

Loudat, T.A., and R. Kanter. 1996. The Economics of Commercial Koa Culture in Hawaii, from Koa: A Decade of Growth—Proceedings of the Symposium. HFIA, Hilo, Hawaii.

Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Reid, R., and G. Wilson. 1985. Agroforestry in Australia and New Zealand. Goddard & Dobson, Victoria, Australia.

Stephen, P., and R. Reid. 1999. Australia Master TreeGrower Farm Forestry Economics Exercise. School of Forestry, The University of Melbourne.

Sullivan, G.M., S.M. Huke and J.M. Fox, Eds. 1992. Financial and Economic Analysis of Agroforestry Systems. Proceedings of a workshop held in Honolulu, Hawaii, USA, July 1991.

USDA NRCS. 1994. Agroforestry: An Integrated Land-Use Management System for Production and Farmland Conservation. Account Name USDA SCS 68-3A75-3-134.

Agroforestry Guides for Pacific Islands

Economics of Farm Forestry: Financial Evaluation for Landowners is the seventh in a series of eight Agroforestry Guides for Pacific Islands, published by Permanent Agriculture Resources with support from the U.S. Department of Agriculture's Western Region Sustainable Agriculture Research and Education (WSARE) Program. The guides can be downloaded from the internet free of charge from http://www.agroforestry.net. Master copies are also available to photocopy free of charge from Pacific Island offices of the Natural Resources Conservation Service (NRCS) or the Cooperative Extension Service (CES) of the University of Hawaii.

Each guide includes a resource section with books, periodicals, and web links for further information on the subject.

1. Information Resources for Pacific Island Agroforestry

Provides an introduction to agroforestry, followed by descriptions and contact information for books, guides, periodicals, organizations, and web sites useful to practitioners of agroforestry in Pacific Islands.

2. Multipurpose Trees for Agroforestry in the Pacific Islands

Introduces traditional Pacific Island agroforestry systems and species. Provides a species table with over 130 multipurpose trees used in Pacific Island agroforestry, detailing information on uses (food, fodder, timber, etc.) and tree characteristics such as height, growth rates, and habitat requirements.

3. Nontimber Forest Products for Pacific Islands: An Introductory Guide for Producers

Discusses the environmental, economic, and cultural role of nontimber forest products. Provides planning suggestions for those starting a nontimber product enterprise. Includes a species table of over 70 traditional Pacific Island nontimber forest products.

4. Integrating Understory Crops with Tree Crops: An Introductory Guide for Pacific Islands

Introduces planning considerations for planting crops with forestry, orchard, or other tree-based systems. Examples of understory intercropping systems in the tropics are included, as well as a species list of over 75 trees, shrubs, and vines used as understory crops in the region.

5. Introduction to Integrating Trees into Pacific Island Farm Systems

Presents eight Pacific Island agroforestry practices that integrate trees into farm systems. Includes silvopasture (trees and livestock), windbreaks, contour hedgerows, live fences, improved fallow, woodlots, sequential cropping systems, and understory cropping.

6. Choosing Timber Species for Pacific Island Agroforestry

Discusses seven steps for choosing timber species that meet the project goals, product requirements, and environmental conditions for a farm forestry or agroforestry project. Includes a species table of over 50 Pacific Island agroforestry species that provide quality wood products, detailing environmental tolerances and multiple uses.

7. Economics of Farm Forestry: Financial Evaluation for Landowners

Introduces strategies for determining the financial returns of small-scale forestry and farm forestry projects. Includes a discussion of the advantages and disadvantages of investing in farm forestry, and the steps in determining the costs involved, estimating returns, and comparing farm forestry with other land uses. Also explores the potential of improving economic picture through value-added strategies or agroforestry practices.

8. Multipurpose Windbreaks: Design and Species for Pacific Islands

Covers information on windbreak design, followed by a discussion of planning considerations for multiple-use windbreaks for timber, fruit/nut production, mulch/fodder, or wildlife habitat. Includes species table of over 90 windbreak species for Pacific Islands, detailing environmental requirements and uses/products.

Agroforestry Guides for Pacific Islands
from: http://www.agroforestry.net