

MASSEY

#12

**DIVERSIFICATION OF  
WAIRARAPA HILL COUNTRY:  
THE POTENTIAL FOR AGROFORESTRY**

**J.G. Spall  
and  
A.D. Meister**

GIANNINI FOUNDATION OF  
AGRICULTURAL ECONOMICS  
LIBRARY

JUN 24 1988



DISCUSSION PAPER NO. 12  
IN NATURAL RESOURCE ECONOMICS  
Department of Agricultural Economics and Business  
Massey University, Palmerston North

March 1988

ISSN 0110-2044

DISCUSSION PAPERS IN NATURAL RESOURCE ECONOMICS

*Available free of charge:*

- No. 1 Economics and the Environment - An Economist's View, 1977 (A.D. Meister).
- No. 2 Issues in the Use of Natural Resources: Land Use Planning, 1977 (A.D. Meister)
- No. 3 A Study of Rural Smallholdings in Taranaki County, 1980 (A.D. Meister & D.S. Stewart)
- No. 4 A Report on the Use of a Travel Cost Demand Model for Recreation Analysis in New Zealand: An Evaluation of Lake Tutira, 1981 (B.S. Harris & A.D. Meister).
- No. 6 The Practices, Problems and Economics of Farm Woodlots, 1983 (P.G. Smaller & A.D. Meister).
- No. 7 Rural Planning and Forestry: Formulation of Policy at County Level, 1983 (D.E. Fowler & A.D. Meister).
- No. 8 A Survey of Studies on Rural Smallholdings (1970-1983), 1984 (A.D. Meister).
- No. 9 Rural Smallholdings in Wairarapa: Desirability and Land Use Issues, 1984 (A.D. Meister & G.D. Knighton).
- No.10 New Cost Benefit Analysis: Useful Aids in Decision Making or Confidence Tricks and Economic Analysis and Soil Conservation Work, 1985 (A.D. Meister).

*Also available at a cost of \$10.00\**

- No.11 The Financial Implications of Forestry Logging Traffic on Rural Roads, 1987 (P.W.J. Clough & A.D. Meister).
- No.12 Diversification of Wairarapa Hill Country: The Potential for Agroforestry, 1988 (J.G. Spall & A.D. Meister).

---

\* GST should be paid on orders within New Zealand (GST Reg.No. 11-205-615). Please add for postage and packing per copy:- within New Zealand \$1.00; overseas surface mail NZ\$2.00, airmail NZ\$7.00.

*Copies of these Discussion Papers are available from:*

The Secretary, Department of Agricultural Economics & Business,  
Massey University, Palmerston North, New Zealand.

ISSN 0110-2044

DIVERSIFICATION OF  
WAIRARAPA HILL COUNTRY :  
THE POTENTIAL FOR AGROFORESTRY

J.G. Spall  
and  
A.D. Meister

February 1988

Discussion Paper in Natural Resource  
Economics No.12,  
Department of Agricultural Economics and  
Business,  
Massey University, Palmerston North,  
New Zealand

## TABLE OF CONTENTS

Table of Contents.....	Page (ii)
Foreword.....	(iii)
CHAPTER 1	
Introduction to Study	
1.1 Study Background and Motivation.....	1
CHAPTER 2	
Methodology	
2.1 The Methodology Applied.....	4
CHAPTER 3	
A Linear Programming Analysis of Agroforestry	
3.1 Introduction.....	26
CHAPTER 4	
A Sensitivity Analysis	
4.1 Introduction.....	58
CHAPTER 5	
Model Limitations and Further Aspects of Agroforestry	
5.1 Model Limitations.....	72
CHAPTER 6	
Conclusions and Implications for the Wairarapa	
6.1 Introduction.....	77
REFERENCES .....	86

## FOREWORD

Falling sheep and cattle product prices and rising on-farm costs have caused a significant decline in real farm income, especially so for hill-country production. Already many new grazing enterprises such as bull beef, goats, and deer have been established. This discussion paper examines the potential contribution agroforestry could make to land use diversification.

Agroforestry has been much in the news over the years. Research carried out by the Ministry of Agriculture and Fisheries and the Forest Research Institute has shown that agroforestry could prove a useful and wise land option for farmers over a wide range of environments. There is now good information on growth characteristics of trees under low planting densities, on performance of livestock under trees and on economic returns. What has been missing thus far is an analysis of agroforestry within a farm system, taking into consideration cash requirements, labour needs, taxation and profitability. In this discussion paper research is described that demonstrates that agroforestry is a viable alternative for hill country diversification.

The research consists of a realistic farm decision making model using a Wairarapa hill country case study farm. The model covers a planning horizon of twenty-one years. Agroforestry was introduced over those years in accordance with cash availability. Although the model concentrates on the financial profitability of agroforestry, some of the intangible aspects of forestry such as erosion control, shelter, aesthetics and shade, contribute further desirable aspects to agroforestry.

This discussion paper is based on post-graduate research undertaken by Mr J. Spall towards his Masters of Agricultural Science Degree. He was supervised by Dr A.D. Meister, Reader in Natural Resource Economics in the Department of Agricultural Economics and Business. The research was funded by the Forest Research Institute.

(iv)

On behalf of the authors I would like to extend appreciation to all those whose help and cooperation made this research possible. In particular, special thanks are due to:

Staff from the Forest Research Institute, New Zealand Forest Service, Wairarapa Catchment Board, and Plant Material Centre;

Also special thanks is extended to the farmers who contributed to the study, in particular the case study farmers, Jamie and Ricky Strang, who willingly gave their time and data for the linear programming model.

Professor R.J. Townsley  
Head, Department of Agricultural Economics and Business

## CHAPTER I

### INTRODUCTION TO STUDY

#### 1.1 STUDY BACKGROUND AND MOTIVATION

In recent years hill country sheep and beef farmers have experienced a marked decline in real farm income. The costs of inputs have risen sharply while

output prices have generally held or more recently have fallen (Taylor, 1984). To counter the impact of this cost-price squeeze, farmers have a number of alternatives. Beyond selling the property these include:

##### (i) Extensification of Production

Examples include: reducing fertiliser application rates, reducing stocking rates per hectare, and reducing labour. While each of these lower output volumes, by lowering costs it is possible to increase net income. Taylor (1982) suggests that under high rates of inflation of input costs, this may well be a desirable move for the individual farmer but can be undesirable for the national economy because of a lower volume of output. In addition, it may lead to reversion of hill country to secondary growth under more lax grazing pressure.

##### (ii) Expansion of Production through Land Acquisition

A significant alternative for many farmers has been to expand production through buying or leasing additional land. Amongst one group of hill country farms (Kaplan, 1979) almost half the owners were leasing land additional to that which they owned, while 10 farmers out of 42 (24 %) had bought additional land in recent years. Again, this can be a desirable move for the individual farmer but can have disastrous social effects on a district where it is associated with a population decline.

##### (iii) Intensification of Production

It is widely recognised that enormous potential exists on hill country for additional output. Such estimates of the potential for increase in stock numbers range between 50 to 300% (Taylor, 1984). For example, it has been estimated that if the 1980-81 stocking rates were improved to the "top" farmer levels over the whole of the North Island, total stock units would increase by 128%.

Economically successful intensification results where the additional revenue from the extra output more than compensates for the higher overheads and variable costs that may be required. In contrast to the first two options an improvement in technical and economic efficiency provides benefits not only to the farmer, but also to the district through the additional inputs purchased and income generated and also to the nation through additional export receipts. A key feature of successful intensification is the management input in all its facets through planning, implementation, and control.

#### (iv) Diversification of Production

A fourth approach to falling profitability is to try alternative forms of production. Diversification shares with intensification the potential to benefit the district and the nation. It requires skillful management but, unlike intensification, it demands entirely new knowledge and skills of the farmer and can be both costly and risky.

It is this last alternative that this study focuses on and in particular the issues involved for farmers diversifying into trees for timber production. Two basic objectives were considered:

1. Is agroforestry in general likely to be a profitable investment for Wairarapa hill country farmers?
2. What factors influence the feasibility of farmer investment in agroforestry?

The study was conducted using a case study farm located in the Wairarapa district occupying the south-eastern area of the North Island of New Zealand.

In chapter 2 the methodology used for the study is described. Primary emphasis is on the development of a whole farm economic model that incorporates both existing agricultural activities and agroforestry alternatives. The optimal feasible strategy for the case study farm indicated by the model is outlined in chapter 3. The results of experimentation with the model to provide solutions for the study objectives are detailed in chapter 4.



In chapter 5 attention is drawn to some of the limitations of the methodology used and some of the broader issues of project evaluation.

Finally, in chapter 6 the implications of the research are discussed with respect to the study's two basic objectives.

## CHAPTER 2

### METHODOLOGY

#### 2.1 THE METHODOLOGY APPLIED

The choice of methodology depends on the properties of the system under review and the objectives of the study. A key feature of the agroforestry system is the time dimension. Trees planted today will probably not be harvested until 28-30 years from now. Therefore, to study the impact of agroforestry on the farm enterprise (its profitability, labour demand and cashflows) the methodology for analysis must be able to incorporate this time dimension. The methodology should also allow optimisation of goals so that the best farm plan can be determined.

A form of model which appears to best meet the requirements of the study is the intertemporal linear programme, particularly those versions with a multiple objective function. Intertemporal linear programming enables the solution of several production periods simultaneously (for a description see Throsby 1962, Rae 1977, Olsson 1971, and Mendoza et al 1986). Such models not only provide solutions for optimum resource use but also consider fully feasibility aspects, the fact that when an investment is made it has liquidity and capacity effects on the farm for a long period of time (Olsson, 1971). If a multiple objective function is used, consideration can be given to the use of agroforestry systems to meet social, ecological and other economic goals beyond profit maximisation (Mendoza et al, 1986).