

**A TREE MODEL FOR HAWKES BAY FARMERS'
TREE PLANTING DECISIONS**

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PREFACE

Forestry has long been part of the farming scene in New Zealand although it has not always been widely practised among farmers. In recent times, as farmers have modified their land use in response to a policy of deregulation, there has been increasing interest in trees on farms. Trees are now seen by the timber industry, local authorities and a growing number of farmers as providing a range of benefits, including shelter, aesthetics, erosion control, drought fodder and financial returns. Increasing attention is now being given to promoting trees on farms. In this Research Report Dr Fairweather examines how farmers decide to plant trees and he develops decision tree models which account for key criteria in the decision making process. This study of trees and decision tree modelling will be of value to those interested in fostering tree planting on farms, and for those interested in understanding farmer decision making.

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SUMMARY

This Research Report presents the results of a regional pilot study of farmers' decision making regarding trees on their farms. A review of both international and New Zealand literature shows that farmers have a variety of attitudes towards trees. New Zealand research has employed widely varied research methods and shows a number of motivations for tree planting. Using the ethnographic decision tree model approach developed by Gladwin (1989) the results of the research show four discrete decision trees for woodlot, shelterbelt, agroforestry and poplar or willow trees. Each decision tree contains elimination aspects, decision issues and constraints. Elimination criteria included beliefs about trees, knowledge about forestry and whether trees were already present. Decision issues typically involved assessment of the costs and benefits of trees, and the constraints included other forestry taking precedence, lack of time and lack of cash this financial year. The results suggest that economic factors play a significant part in farmers' decision making regarding planting trees even though financial returns from trees may not always be significant as a motivation to plant. The report describes the four decision trees in detail and discusses the findings in terms of the existing literature and strategies for promoting trees on farms.

CHAPTER 1

INTRODUCTION: SCOPE, LIMITATIONS AND OVERVIEW

The research results reported here are part of a broad study of the social aspects of forestry in New Zealand. Of particular interest here are farmers' attitudes to trees and forestry on their farms and how decisions are made to plant, or not to plant, trees. The study is based on detailed interviews with a small number of farmers in the Hawkes Bay area and is thus a regional pilot study used to develop an understanding of farmers' decision making. The main objective is to examine farmers' attitudes to trees and, in particular, our understanding of the decision making process. Later stages of the research intend to apply the results of this first stage to develop a questionnaire for a national survey of farmers.

Current tree research in Hawkes Bay includes evaluation of fodder species for drought-prone environments and study of the interaction between trees and surrounding pasture growth. These research projects have been set up in conjunction with this research project in order to provide an integrated approach to encouraging tree planting on farms. This project thus parallels the biological research by providing an improved understanding of the factors which influence farmers' decisions to incorporate trees into their farming systems. While the focus of the biological research is on fodder species, the research here focuses broadly on all forestry and tree options. This general focus is due to changes in the funding structure of the research project which included additional funds from the Ministry of Forestry.

Forestry and tree planting are defined broadly to include planting of any kind of tree. Trees can be planted in a variety of ways including woodlots, shelterbelts, agroforestry or as poplar and willow poles. The focus was on all of these options and all species of tree. Large scale activity constituting plantations were not studied because no cases of this were found in the sample of farmers studied. While some farmers in Hawkes Bay may have a plantation the total number of such farms is probably very low justifying the focus on all the smaller-scale options.

This report provides a review of overseas literature on farmers' attitudes to forestry and then thoroughly reviews the equivalent New Zealand literature. The existing studies of farmer attitudes towards trees provides background to the topic of farmer decision making. This topic is briefly reviewed by way of introducing the method adopted in this study, namely the ethnographic decision tree model approach. The method is described in detail before going on to present the results. The results are discussed in terms of what they say about our understanding of tree planting decision making, with reference back to the existing New Zealand literature. Finally and briefly mentioned are some implications for policy and practice and an outline of future research.

Not included in this research are a number of topics relating to forestry and tree planting, namely the social and economic implications of increased forestry on farms. Forestry development will have effects on the local economy and ultimately on the character of social organisation. These broader issues are not part of this research project and remain to be addressed as forestry continues to grow in importance.

CHAPTER 2

FARMERS' ATTITUDES TO FORESTRY

2.1 Introduction

This chapter reviews literature derived from overseas and New Zealand sources. The main focus is on farmers' attitudes to trees or forestry. Typically, the research examines attitudes to forestry with a view to learning how forestry on farms can be encouraged or supported. However, the reasons for this approach are variable. The European situation, reviewed first, is one in which forestry is being encouraged as an alternative land use where land is to be taken out of traditional primary production. In New Zealand, forestry is seen by some as an economically competitive land use option with benign environmental consequences. Despite the different motivation for forestry in Europe, the research is relevant to the topic of farmers' attitudes to trees. In particular, the literature illustrates the variety of factors which impinge on a farmer's decision to plant trees. The chapter concludes with an overview of the New Zealand literature.

2.2 International Research on Farmers' Attitudes to Forestry

Farmers and landowners are able to make investment decisions about the type of production from the land they farm. These decisions are important for they lead to the development of capital stock on farms, influence demand for inputs and have flow-on effects beyond the farm gate (Brase and La Due, 1989). Many factors influence investment behaviour. Brase and La Due list 23 factors which are important as evidenced in an extensive literature review on farmer investment behaviour. The decision making process is made complicated by the presence of many factors but despite the complexity, investment decisions are made.

Forestry in many countries appears to be a second priority for farmers. For example, in France between 20 to 25 per cent of privately owned forest belongs to farmers who exhibit negligible interest in forestry (Faucher, 1984). These farmers are indifferent to forest development policies. In the U.S. context it is recognised that for the majority of non-industrial private forest landowners timber production is not a primary objective (Fairweather and Kurtz, 1982). In their study of landowners on the Missouri Ozarks Fairweather and Kurtz found three types of landowners. While the Practical Forester was interested in producing timber, the Dedicated Farmer was interested in grazing and would convert forestry to farm land where possible. In addition, the Concerned Ecologist type valued trees for conservation, aesthetics or wildlife.

Other studies of this type have examined the forest owner in particular to find that social factors play an important role in investment decisions. Riihinen (1970) found that while attitudes to forestry and level of forestry knowledge were important in forestry decision making, so also were cultural and individual variables. Similarly, Hahtola (1967) found that while the institutional setting and traditions were important, so also were individual predispositions and attitudes. This direction to the research has been summarised by Williams (1988:87) in his monograph on decision making in forest management:

In many cases, the decision to plant trees depends on factors other than financial ones. It may be decided on the fact that a regular supply of timber

is needed for a sawmill, that fencing materials are needed for estate repairs or that the woods are needed for shelter or for amenity.

Williams provides the forest manager with the tools to make a rational business decision comparing costs and benefits while acknowledging that the decision to plant trees is highly contingent and may proceed for apparently non-rational reasons.

Complexity in investment decision making derives in large part from the variety of social values farmers see in trees. These values are recognised by researchers but not always incorporated into research design. The fact that trees have a number of values associated with them is recognised routinely in the forestry and agroforestry literature for developing countries. For example, in Costa Rica a study of farmer motivations for tree planting for a fuelwood plantation project found that farmers' decisions were based on the non-material benefits such as protection from the elements (Jones and Price, 1985). And in discussing rural development programmes Lovelace (1985) emphasised cultural values and farmers' attitudes to the programme. He recognises also the differences between farmers' values and those of the development agencies. The recognition of diverse values associated with trees is the basis for those books which emphasise the importance of social factors in forestry project success (e.g. Burch, 1991).

The typically lower investment priority put on trees by farmers, and the diversity of values they associate with trees, can lead to policy issues when governments decide that more trees should be planted. The issue becomes: how best to encourage farmers to plant trees? The main response to this question has been to undertake research that seeks to learn about farmers' attitudes to trees. Some of this research goes further and attempts to assess how farmers would respond to particular programmes. In the review that follows attention is given to British research of this type. The first three items focus on attitudes to forestry and the remainder focus on land diversion issues.

An early interview survey of 50 farmers in Wales found that 62 per cent had a favourable attitude to forestry while 36 per cent had an unfavourable attitude (Thomas and McLean, 1984). Their attitude was to accept forestry if they could get something in return such as landscape improvement, monetary gain or employment. The possibility of increasing the incidence of foxes was viewed negatively. In a 1984 and 1985 survey of farm woodland in Scotland and Northern England, 60 per cent of farmers said they had an area of trees they defined as a wood (Sidwell, 1989). Over 50 per cent of the 708 usable replies indicated a positive view of trees, and shelter, closely followed by amenity was given as the main benefit of woodland. More recently a questionnaire survey of 36 farms in southern Scotland showed that adverse attitudes to forestry may provide a significant obstacle to policy initiatives (Scambler, 1989). The majority of farmers had no interest in forestry. The degree of interest in forestry varied with age (older farmers had least interest), farm size (farmers on larger farms were more likely to consider forestry), farm type (forestry more likely to be adopted on poor land) and tenure (tenant farmers have an unfavourable attitude to forestry). The author concluded, despite the small sample size, that the rate of adoption of forestry on farms may be limited even when forestry development is positively encouraged by government policy.

Finally, there are the reports of research which have examined farmers' attitude to trees with respect to policies to take land out of production and encouraging tree planting. There are both UK and European agricultural policy schemes coming forward which rely on land

diversion to achieve a variety of supply control, social and environmental policy goals. Kellener and O'Hara (1987) surveyed 144 farmers in the North West of the Irish Republic to assess attitudes to the three options to the EC pre-pension proposal. While 44 per cent thought that the transfer of land to a first degree successor was attractive few (11 per cent) said they would give it serious attention. A majority of 65 per cent were against the idea of taking land out of farming. Nearly one half thought that tree planting was the best option but many were opposed to planting all their land. Apparently, Irish farmers in the face of requirements to change land use look to forestry with some favour - at least in terms of intention.

More detailed work has been done by Gasson (1988). In a review of literature Gasson makes judgements about the likely impacts of policies to encourage conservation, tree growing or land withdrawal. Results indicate that farmers' responses to these schemes are influenced by willingness to respond, ability to respond, and the characteristics of the scheme. This preliminary work was followed up by a survey of farmers in Suffolk, West Sussex and Hampshire (Potter and Gasson, 1988). The results showed that land diversion will have most appeal to well-placed farmers already involved in forestry or conservation. Thus, the voluntary schemes may not be especially useful for encouraging land use change on many of the farms. The survey questionnaire also asked farmers to state the minimum sum needed to persuade them to enrol in the scheme to take land out of arable production (Gasson and Potter, 1988). On average, the farmers wanted UK£348 per hectare to fallow cereal land, UK£336 per hectare to convert it to pasture or UK£437 to plant trees. The authors concluded that there was some support for their hypothesis that farmers' responses to land diversion initiatives depended on an interaction of conservation attitudes and financial constraints.

The international research introduces us to the complexity of forestry investment decision making due to social factors, including the social values of trees. In the UK there are policies designed to encourage forestry in order to take land out of traditional primary production and contemporary research shows a sluggish response even when financial incentives are available.

2.3 New Zealand Research on Farmers' Attitudes to Forestry

One of the earliest surveys of farmers' attitudes to trees was undertaken by members of the Farm Forestry Association in 1974. Frost (1974) reported that members of the Association interviewed farmers in each of the Association districts and a total of 767 completed questionnaires were obtained, of which 46 per cent had existing woodlots and 54 per cent did not have woodlots. Frost found that few farmers (one quarter) had used the prevailing incentive schemes. The main reasons for planting were:

(1)	Shelter	56%
(2)	Wood for farm use	51%
(3)	Best land use	48%
(4)	Direct financial gain	40%
(5)	Beautification	39%
(6)	Weed control	24%
(7)	Diversify production	22%
(8)	Other	20%.

Farmers not planting gave shortage of labour and time, and lack of knowledge as the main reasons. The results of this comprehensive national and non-random survey clearly show that financial gain was not as important as shelter and wood for own use. However, financial gain was still quite important at 40 per cent and this was ranked almost the same as beautification at 39 per cent. These findings set the scene for later New Zealand research which will show repetition of the same themes.

Another detailed survey of farmers' attitudes to trees was reported by Smaller and Meister (1983). The aim of that study was to learn why farmers planted trees and to examine the profitability of farm woodlots. The survey population comprised 1,800 landowners in part of the Wellington Conservancy each of whom had farm woodlots. The sample of 160 persons, stratified by size and location, was surveyed by questionnaire. In addition, six case studies provided additional data on the costs and returns from recent timber harvests. The sample was made up mostly of farmers, but 20 per cent were non-resident forest owners who declared no full-time, permanent labour involved in the property. This study thus focused on forestry-oriented landowners in that all cases had a farm woodlot of some sort. If it was the case that many farms in the Wellington Conservancy had no farm woodlots then the results would not properly reflect typical farmer attitudes.

Results showed that for those landowners with suitable land for planting the main reasons for not planting were that returns were uncertain and that land in grazing was more profitable. Further, the main disadvantages of woodlots were the extra work and time needed, and the early cash expenditure but returns later. Despite these reservations about woodlots the landowners recognised a number of benefits from trees. Financial benefits and shelter benefits were the most frequently selected beneficial aspects of woodlots. Also perceived as beneficial were erosion prevention, aesthetics and cheaper materials.

Smaller and Meister concluded that since planting for a dual purpose or multiple benefit was more likely than planting for a single purpose, production of timber by itself was of secondary importance to the sampled farmers. Trees were not seen as another crop, especially when considering that aesthetics were quite important. Thus financial benefits from planting were not enough to increase the rate of planting. It should be noted that the economic analysis provided by the six case studies showed that the gross margins for forestry were less than for pastoral production. This finding supports the authors' claim that financial factors were not significant in the decision to plant trees at this particular time. In 1983 there were considerable incentives for pastoral production. Since then the financial picture has changed considerably and forestry returns now are thought to be high (Levack, 1991; Hawke and McLaren, 1989).

Another detailed study of farm forestry in one region was undertaken by Revington (1984). Of the 904 farmers with forestry in Northland, Revington interviewed 94 in order to examine characteristics of forest owners as these were linked to attitudes. Revington found that farmers' attitudes to forestry were quite different from foresters' attitudes to forestry. Non farmers had larger forest holdings and were motivated mostly by economic factors while farmers had, in addition, practical, farm-related motives and aesthetic reasons. Foresters carried out significantly better silvicultural activity, used technical assistance and hired skilled forestry contractors. Revington also considered the needs for infrastructural development to assist forestry in Northland. The results show a contrast between farmers and foresters, and reinforce the earlier findings that farmers have varied and non-economic motives for planting

trees.

Two studies that succeeded Smaller and Meister (1983) and Revington (1984) focused on forestry in the South Island High Country. The first of these more specific studies was Jakobssen (1984) in which farm forestry on one particular farm was considered in detail. A discounted cash flow analysis showed that forestry investment entailed unfavourable financial returns. However, tree planting was considered by the farmer to be worthwhile in spite of uncertain returns because the benefits of increased production with shelter, diversification, erosion control, landscape enhancement, provision of employment, provision of an asset for the next generation and improvement to the working environment. The rate and extent of planting were constrained by the availability of capital.

We can see in this single case study the important elements of farm forestry decision making in which a number of less easily quantifiable advantages of forestry are used to rationalise or justify considerable forestry development. Apparently, for the farmer in this case study, the net assessment of the benefits of forestry outweighs the uncertain financial returns.

Murray (1986) also examined high country farmers, this time interviewing 25 farmers on 24 farms. This study recognised that the attitudes, values and personal objectives of farmers and their families were important in decision making. Murray selected all farms in three locations and examined quantitative data in detail to test hypotheses about the relationships between key variables. The two main measurements of forestry activity were length of shelterbelts and woodlot area. Many aspects of forestry decision making were examined.

Results showed a number of attitudes to forestry. Half of the farmers thought that the economics of forestry were either good or very good, and 68 per cent saw forestry investment as better in 1986 than it had been because of a recent timber price increases. The major constraint on planting was lack of finance: 11 farmers were in this category while seven of the nine farmers who had higher than average net farm surplus stated reasons other than not enough finance. Other constraints to planting were 'better returns elsewhere' and 'delayed return'. Labour was not a constraint to planting. Shelter was the main reason for investing in forestry with 20 farmers selecting this option as their first choice. The second choice was future income. Another important reason for planting was aesthetics. The main reason against investing in forestry was delayed income, with 12 farmers selecting this option as their first choice and 17 farmers selecting this option over all choices.

Murray found that shelter and woodlots were not a high priority in the early stages of farm development. Further, there was no clear relationship between net farm surplus and length of shelter or woodlot area. The farmers would resist exotic forestry on grazing land and large-scale commercial forestry on their farms. Murray concluded that stage of farm development, followed by personal objectives, was the most important factor in rate of forestry expansion.

In this descriptive and exploratory study many of the key variables relating to forestry on farm were examined in detail. However, some reservations are warranted for the following reasons. First, the small, non-random sample makes problematic any assessment of the relevance of the findings from the 25 cases. We do not know whether the findings apply to the population of farmers in other areas. Second, within the framework of analysis, it is not certain that some of the findings and interpretations are valid. For example, the finding that

there is no relationship between farm surplus and forestry activity seems to weaken the claim that forestry development is linked to commercial viability of the pastoral industry. Further, some of the analyses do not control for farm size by way of measuring partial correlation coefficients. Despite these critical observations, the study does advance our understanding of high country farmers. In particular, it shows how non-financial considerations are important in farmers' decision to plant trees.

To balance the research on farmer attitude to trees reviewed above are some data based on national surveys of farmers. Pryde and McCartin (1984) began this research by including forestry questions in their 1984 annual survey of farmers. Of the 1,525 farmer responses, 1,063 or 70 per cent had planted trees on their farms and they gave their reasons for planting as listed in Table 1. Of the remaining farmers, 414 or 27 per cent had not planted trees and gave their reasons as listed in Table 2. The remaining 48 or three per cent of farmers did not reply to the question. In general, nearly three quarters of farmers said that they have planted trees.

Table 1
Major Reason for Having Planted or Intending to Plant Trees

	%
Best land use for these areas	20
Income from commercial sale	2
Your own use	3
Beautify landscape	13
Increase my land value	1
Shelter for stock or house	46
Diversification from farming	4
Conservation	8
Other	3

Table 1 shows that for all those farmers surveyed who had already planted trees most of them planted trees for shelter. There were 46 per cent who selected this reason and it is the dominant factor. The other major reasons are that it is considered the best land use (20 per cent) and to beautify the farm landscape (13 per cent). This research is the first indication of what the farm population was thinking about trees in 1984. Compared to Smaller and Meister's 1983 survey of woodlot owners in the Wellington conservancy where financial and shelter benefits were selected in equal frequency, the results from Pryde and McCartin (1984) show more emphasis on shelter and less on timber income. Murray's results in 1986 more closely match the national survey data in that the reasons for investing in forestry are diverse with shelter as the most frequent choice, and then aesthetics ahead of income.

Pryde and McCartin also asked those farmers who had not planted trees on their farms their major reason for not planting. The results are shown in Table 2. Nearly one half (49 per cent) of all farmers choose taking land out of production. This probably reflects the view that grazing is the best investment giving better returns than forestry. It also reflects the prevailing view that trees typically are planted as woodlots and compete with pastoral

production. The other major reason for not having planted was lack of money. These results have some similarities with Murray's (1986) findings that the major constraint for farm forestry was lack of available capital. However, farmers nationally were saying in 1984 that taking land out of production was the major reason for not planting. Few farmers admitted to not liking trees.

Table 2
Major Reason for Not Having Planted or Not Intending to Plant

	%
I don't like trees	2
I don't have enough money (other farm purchases take priority)	17
Takes land out of grazing	49
Inadequate return on investment (don't want money tied up 20-40 years)	10
I don't know enough about tree growing	6
I don't like the uncertainty and inflexibility	6
Other	12

Pryde and McCartin repeated and extended the questions on forestry in their 1985-86 survey of farmers at the request of the Forest Research Institute. The results from these questions were analysed and presented by Morey (1988) at an agroforestry symposium in Rotorua in 1986. The questions were developed to include definitions of shelterbelts, woodlots and agroforestry. Of the 1,907 farmer responses, 54 per cent had established shelterbelts, 30 per cent had established woodlots and seven per cent had established agroforestry. Since some farmers would have had some of each of these three options it is not possible to add the percentages up to learn what proportion of farmers had planted trees on their farms. No comparison to 1984 is possible for this dimension. However, the tighter definitions used in this later survey are an improvement in precision.

The other important attitudinal results are measured by an average score where a score of one indicates very important and a score of five indicates very unimportant. The following three tables use this importance score. Table 3 shows an averaged importance score for eight different uses for forest trees on farm as derived from the whole sample. Clearly the most important use is for shelter for both stock and/or crops and for buildings. Less important uses are landscape and aesthetics, best land use and erosion control. The lowest scored use is profit from sale of wood where a score of almost 3.0 is equivalent to neutral.

Table 4 shows the averaged importance score for ten reasons for not planting forest trees as derived from the whole sample. It should be noted that a farmer may rate a reason as important for not growing trees but this may not be particularly influential in his or her decision. Farmers would be responding in general terms to this question and saying what they thought would apply to farmers as a whole. The question did not specify the reasons for those farmers who had in fact not planted trees. The important reasons for not planting are the competition in land use and lack of finance. Farmers also see the low return and the

length of time before returns as reasons against planting. The reasons with a score of 3.00 or more are unimportant or very unimportant, and the scores suggest that lack of information and district schemes are not prohibiting planting.

Table 3
Importance of Eight Uses for Forest Trees on Farms

Shelter for stock and/or crops	1.89
Shelter house(s) and farm buildings	1.94
Landscape and aesthetic benefits	2.27
Best land use for steep and/or low productivity country	2.40
Erosion control	2.43
Supply of wood for on-farm use	2.82
An investment which increases farm value	2.86
Profit from sale of the wood produced	2.96

Table 4
Importance of Ten Reasons for Not Planting Forest Trees

Takes land out of agriculture and horticulture	2.56
Lack of finance	2.58
Inadequate return on investment	2.64
Expected revenues too far in the future	2.64
Already have or will have sufficient area in trees	2.90
Prefer present landscape and aesthetic benefits	3.05
Lack of suitably skilled labour	3.14
Lack information on agroforestry management	3.28
Lack information on growing trees	3.29
Restricted by district scheme	3.61

The results from the two national surveys are very useful for examining the farm population and the activities and attitudes of farmers. Comparing the two surveys shows some similarities. The 1984 farmers gave shelter, best land use and beautify landscape as the major reason for planting trees. In the 1985-86 survey farmers said that shelter, landscape/aesthetic benefits and best land use were the important uses of trees on farms. While the questions asked about trees each time were slightly different the results show a consistent pattern: most importance is given to shelter and then some importance is given to either best land use or aesthetic benefits. Income or profit is ranked very low or seen as of neutral importance. The question on reasons for not planting in the two surveys were quite similar and similar results were obtained. In both cases the important reasons for not planting were the fact that forestry takes land out of production, lack of money, and inadequate return on investment. Generally then in the mid 1980s farmers in New Zealand saw forestry as a means to gain shelter and aesthetic benefits. They lacked finance and rated other farm expenditures as more important because they saw forestry as taking land out of production and providing an inadequate financial return. Planting that did occur was seen as the best land use for steep and unproductive areas.

A later, regional survey of farmers in Hurunui and Clutha Counties (Fairweather, 1987), in the South Island, has some indication of attitudes to forestry in the light of changes to farming since 1984. Of the random sample of 384 farmers there were 87 or 23 per cent who had undertaken new land uses, and of these 12 or three per cent of the total had planted trees. Another 68 farmers intended undertaking new land uses and of these there were 19 or five per cent (the largest group) intending to plant trees. Combining these data show that a total of 31 farmers or eight per cent had undertaken or intended planting trees as a new land use. This survey is suggestive of changing farmer attitudes to forestry in the light of deregulation in primary production since 1984.

The topic of farmers' attitudes to trees has been taken up again recently by Enevoldson (1990). In this recent study 50 farmers near Rotorua were interviewed to learn about their forestry management objectives. Results to the question on reasons for planting, using the same format as Morey (1988), showed a similar pattern of response with low emphasis on planting for profit or to increase farm value, and high emphasis on erosion control, shelter and aesthetics. About one half of the surveyed farmers regard cash flow as too limited to finance trees. However, 86 per cent of the farmers with woodlots did finance them from cash flow. The remainder who specified other financing used borrowing (two per cent) or joint ventures (six per cent). According to Enevoldsen, another constraint to planting trees was the availability of labour, although only 20 per cent thought it would be a problem to find labour.

Enevoldsen examined farmers' knowledge of forestry costs and returns in comparison to farming. While their knowledge of farming costs and prices were 73 per cent correct their knowledge of forestry costs and prices were 11 per cent correct. Their knowledge of good forestry was 57 per cent correct. Only 20 per cent of farmers knew that taxation for forestry was the same as for farming.

Economic assessment of forestry and farming investment was carried out using standard costs and prices for forestry and the farmer's own interest rate and income per hectare. The results of this analysis showed that for farmers on a 33 per cent marginal tax rate 67 per cent would earn more money by growing trees. For farmers at 24 per cent tax, 57 per cent

would earn more, and for those at zero per cent tax, 25 per cent would earn more. It must be noted that farming income has been low in recent years which now makes forestry appear more profitable. Further calculations were made based on what the farmers said they would like to earn in a year from investing in trees, taking into account that it would take 30 years before they could fell the trees. Only about one quarter of farmers would be satisfied with income from trees. Long rotation length increases the level of profit required. Despite these apparently low levels of satisfaction with financial return, of the two areas studied there were 77 per cent and 96 per cent of farmers respectively who intended to plant in the next five years. For those farmers intending planting in the next five years nearly one third (32 per cent) intended planting agroforestry.

Another recent study of farm forestry (Stuart, 1990) examined farmer attitudes to agroforestry in South Otago. This study included 20 farmers, some of whom were advanced in forestry development and some of whom were not advanced in forestry development. Since 11 of them were members of the Farm Forestry Association this non random sample included many with a high proportion of farm forest development. The results showed that the main purpose for planting was for stock and pasture shelter. A number of problems with trees were identified including: growing too large and falling over, barley grass around shelter belts, suckering of Lombardy Poplars when land nearby is cultivated, and incompatibility with cropping. Factors influencing farmers not to plant trees were the cost of fencing, poor returns and slow returns. Nine out of 20 farmers were unaware of current tax exemptions. Despite the perceived problems with trees a number of encouraging factors were identified. These included: retirement benefits, good grazing, aesthetics, shade, improved stock movement.

The two recent 1990 studies confirm the earlier findings by showing low awareness of forestry profitability and taxation provisions.

2.4 Conclusion

The literature reviewed here shows that farmers plant trees for a variety of reasons and are generally reluctant to plant trees. From the farmers' point of view trees provide a variety of benefits, with financial benefits not accorded high priority.

The New Zealand Literature on farmer attitude to trees reviewed above is now developed to include nine diverse surveys of farmers. There are five studies with small sample sizes (one to 94) in a variety of regions and in varied depth (Revington, 1984; Jakobssen, 1984; Murray, 1986; Enevoldsen, 1990 and Stuart, 1990). At the other extreme are two large sample random surveys of all farmers in New Zealand (Pryde and McCartin, 1984 and Morey, 1988). Between the two extremes are a national non-random sample (Frost, 1974) and a random sample provincial study (Smaller and Meister, 1983).

The literature tends to show that farmers in New Zealand plant trees for a variety of reasons including, in approximate order of priority, shelter, best land use, aesthetics and then for income. At the time of most of the research farming returns were better than they have been in recent times so that it is understandable that grazing returns were more important to farmers. This means that shelter was important because it was fairly quickly provided by trees and supported grazing activity. Perhaps, then, it is no surprise that forestry income

ranked so far behind the other reasons. From the farmers' point of view to emphasise forestry income would be problematic for at least two reasons. First, it flew in the face of good grazing returns and low forestry returns. Second, it would perhaps appear foolish to say that one's main reason for planting was for financial gain when one had to wait 30 years. Far better to justify planting in terms of shelter, best land use and aesthetic benefits.

Another observation of the New Zealand literature concerns the methods typically used. In most cases, for both small or large samples, the aim has been to identify the range of attitudes to trees. Less emphasis has been given to identifying which particular factors in decision making were important. Where the importance score was used for the national surveys, these results report importance as defined for all respondents thus overlooking particular or peculiar combinations of reasons for planting. In other words the average score may comprise two or more groups of respondents, where each group has a distinctive viewpoint. Further, this attitudinal research does not specifically address the process by which decisions are made to plant, or not to plant, trees. Finally, little attention has been given to the planting of poplar or willow poles, and some of the attitudinal studies have not linked attitudes to actual tree planting on the farm.

Most of the New Zealand research reviewed above occurred in the 1980s, presumably reflecting a growing recognition of the potential of forestry on farms. This recognition has been spearheaded by forestry and other researchers, and by those farmers already interested in farm forestry, and is derived in part from growing awareness of the importance and profitability of forestry investment. However, the mid-1980s national surveys show that this factor was not significant in farmers' decisions to plant trees. We do not know at the present time what farmers in New Zealand as a whole are thinking about forestry. There is a need to reappraise farmers' attitudes to trees and forestry now that the economic picture has changed, and to examine the particular characteristics of farmer decision making. This latter need is the subject of this study.

CHAPTER 3

METHOD : THE ETHNOGRAPHIC DECISION TREE MODEL

3.1 Introduction

The main objective of this research is to develop an understanding of farmers' decision making regarding trees. To achieve this objective it is necessary to move beyond attitude or opinion surveys and examine actual tree planting decision making for the winter season of 1992. This chapter describes the ethnographic decision tree method used to learn about farmers' decision making. It begins by introducing the topic of decision making generally before describing the main features of decision tree modelling. The interviewing procedure is described before concluding the chapter with a description of some of the limitations of the method.

3.2 Farmers' Decision Making

The international and New Zealand literature on farmers' attitudes to trees shows some similarities. In New Zealand and the United Kingdom farmers share the view that trees are good for shelter and aesthetic benefits but they are not ranked highly in terms of financial return. In both cases there has been a reluctance to plant trees even when there were government incentives to support farm forestry. Underlying this apparent reluctance to plant trees is a complex decision making process regarding land use decisions. It is relevant now to consider some aspects of decision making itself.

Brase and La Due (1989) in their review of factors influencing farmers' investment behaviour observe in the literature that researchers adopt either an economic perspective or a socio-economic perspective. Economic models of investment behaviour typically use mathematical models using price and other variables in equations in order to predict the behaviour of decision makers under a variety of circumstances. Proponents of socio-economic models supplement economic variables with attitudinal, personality and behavioural factors. This research has attempted to describe and integrate all non-economic variables including age, education, farming experience, ownership, farm size, farm type etc.

Bryant and Johnston (1992) extend this view of decision making and describe three models. First, in the rational model the decision maker exhaustively analyses the problem, identifies all possible solutions, and then finds the best solution. Critics note that the model is unrealistic and information is often incomplete. Second, there is the disjointed-incrementalist approach in which the decision maker focuses only on policies that are inherently different from existing policies and typically only a small number of policy options and their consequences are considered. There is continuous adjustment of goals, objectives and strategies. Finally, there is the mixed scanning approach in which a problem is defined and a general assessment of the entire situation is undertaken. Then there is detailed attention given to a small number of promising options followed by information collection and analysis. Proponents argue that this third model is an accurate description of the way decisions are actually made.

Clearly, the relevance of each model depends on the use to which it is to be put. An economist might find the rational model useful especially if the variables to be analysed are readily measurable. The disjointed-incrementalist model might be useful in studies of satisficing behaviour or the role of inertia in farm decision making. The mixed scanning approach might well apply to a farmer seeking to increase farm revenues.

The general characteristic of all of the above approaches to farmer decision making is that to some degree they reflect what the researchers believe to be important in decision making. In particular, these models have decision makers considering a range of options at some point in the decision process. Gladwin (1989a) in her study of agricultural decision making proposes a cognitive approach which better reflects actual decision making and explicitly rejects expected utility theory of choice where people consider all, or many, options. Gladwin's main point is that people make decisions by comparing alternatives, not by ranking options. They use decision criteria with discrete yes or no outcomes. A decision to do something is reflected in a decision tree composed of a sequence of discrete decision criteria.

Gladwin (1989b) advocates a comprehensive method which is used to develop indigenous knowledge systems and decision tree models. The research begins with the assumption that decision makers are experts and the researcher has the task of learning their decision criteria. These criteria are integrated in a decision tree and are then developed into a formal model. Key factors in decision making are thus made explicit. This contrasts to some other approaches like factor analysis in which the researcher has to guess why a subject makes a decision in a particular way. Finally, the decision model after being developed and refined by preliminary interviews is tested against other subjects in the group under study.

3.3 Features of Decision Tree Modelling

Decision tree research (Gladwin, 1989a & 1989b) examines real world decisions such as buying fertiliser or not buying fertiliser. It has application to any area of human activity where a decision is made and while it is based on individual ethnographic interviews the decisions of a group of people are examined and interpreted by way of developing a decision tree model. The method uses ethnographic interviewing to elicit from the decision makers themselves their decision criteria which are then combined in the form of a decision tree or set of 'if-then' rules or 'expert systems'. The researcher regards the subjects as experts and seeks to learn from them and to discover cultural meanings: in this way the model is 'culturally tuned' by the specific group of individuals.

The research process involves first developing the model and then later testing it. Model development is iterative and refers back to cases to constantly refine the model. Because tree models use realistic assumptions about cognitive abilities they can be tested. Once the model is developed it can then be tested against a different group of people and evaluated for its success rate. Testing involves seeing whether the model predicts what the farmer actually does. If the model predicts 85-90 per cent of individual choices it is adequate. This testing phase is not part of the present research.

The model itself contains decision criteria in the form of two alternatives or it contains constraints that must be met before an outcome is achieved. Criteria and constraints have discrete yes/no outcomes that are mutually exclusive. For any one final outcome, such as planting trees, there can be different pathways reflecting different decision criteria and

constraints. Decision criteria can involve 'elimination by aspects' that relate to characteristics of a person (e.g., are you married?) or they can contain ordering of aspects (e.g., what is the cost of fertiliser versus credit?).

In the case of the decision trees developed here for planting, or not planting trees, a number of specific points are relevant. First, initial attempts to develop one decision tree were unsuccessful because more than one decision was involved. Farmers have a number of choices when deciding to plant trees. They can plant trees for a woodlot, a shelterbelt, agroforestry, or poplar and willow poles for shelter and shade, or trees for other purposes such as nut production, nectar, pollen and aesthetics. To best represent farmers' decision making a separate tree for each of the main options was developed. The main options were: woodlot, shelterbelt, agroforestry and poplar or willow poles.

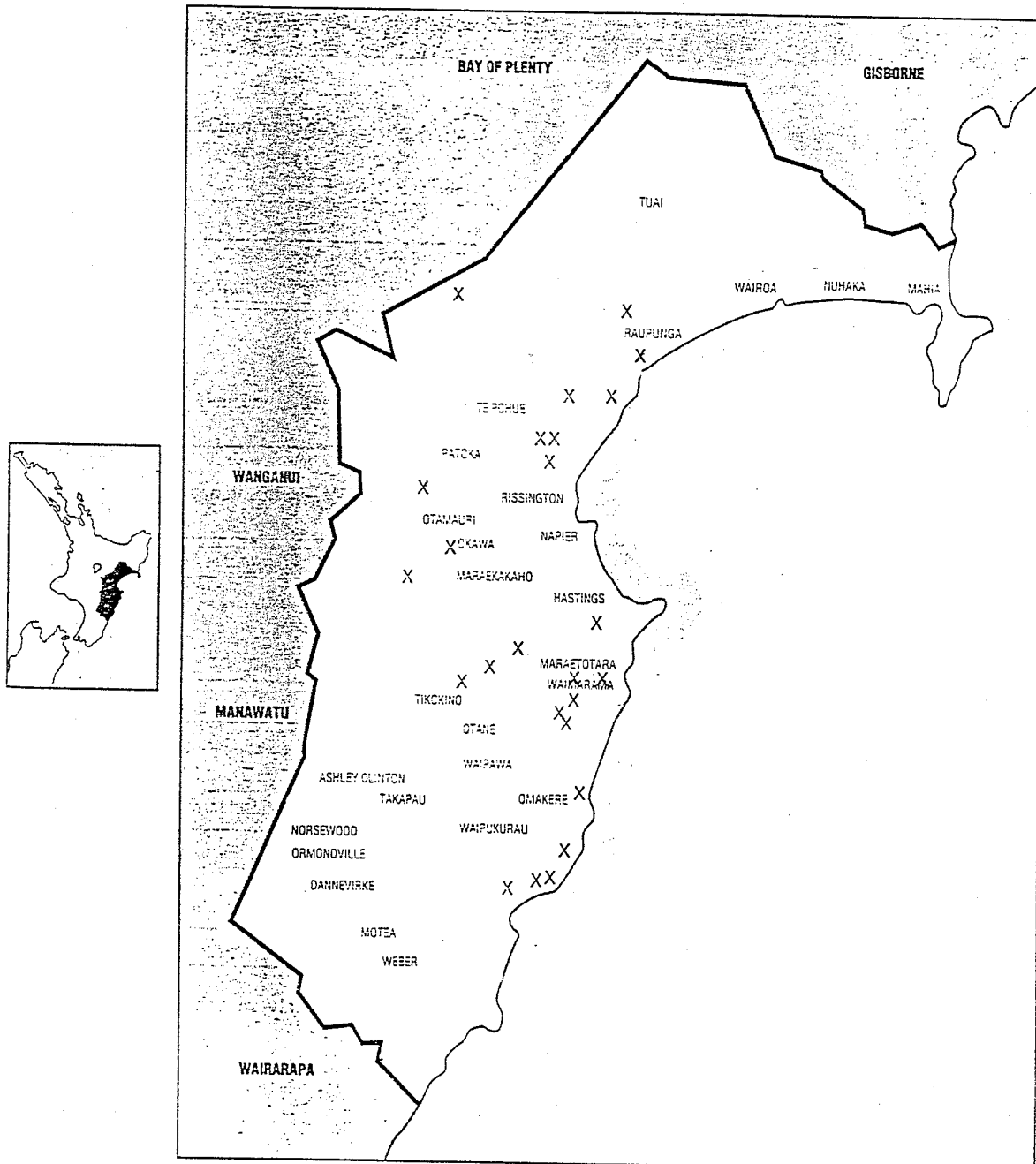
Second, the main purpose of this research is to identify which factors influence farmers' decisions to incorporate trees into their farming systems. It is important to focus on developing the decision tree models and identify the key factors for why, or why not, trees are planted. These models can be developed using in-depth interviews with a small, non-random sample of farmers. The task is to discover how farmers make their decisions and to identify their decision criteria. Not included in this research is testing the model on a different group of farmers. This later phase of research accepts that the dimensions of the models are adequate and can show how the population selects different sets of decision criteria. This testing both corroborates the adequacy of the model and shows which decision criteria are important in terms of the farm population.

3.4 Interviewing and Data Analysis

During March and April of 1992 a total of 18 detailed interviews were carried out in Hawkes Bay. Farmers were selected with the help of a local MAF official and chosen to represent the variety of physical features and rainfall regions in Hawkes Bay. Figure 1 shows the distribution of the selected farms in Hawkes Bay. The list of farmers included those who were planning to plant trees and those who were not. Of the total number of farmers interviewed, most were positively oriented to planting trees in that they had recently planted or wanted to plant this winter. The remaining farmers were not positively oriented to planting trees in that they had either not planted trees on their farm at all or had planted very few trees. Generally, there appeared to be few farmers in the latter category as judged by the difficulty of finding farmers not interested in trees.

The interviews took place on the farms. All subjects were told of the general purpose of the research and were asked to describe their farm type and size, and their recent plantings, if any. Then they were asked to describe their intended tree planting, if any, for the coming winter season. Once the general situation had been established, tree oriented farmers were asked two key questions: why they planted trees, and what constrained them from planting trees. Farmers not oriented towards planting trees were asked about their attitudes to woodlots, shelterbelts, agroforestry, and poplars or willows. The interviews were unstructured and few questions were asked, except to allow explanation. Occasionally a summary of an account was proffered to check that the understanding being developed was accurate. This general format of a few key questions was followed for all subjects. All interviews were tape recorded and detailed notes of each interview were made during the interview.

Figure 1
Distribution of Farms Sampled in Hawkes Bay



Towards the end of the interview a list of questions was checked to make sure that some issues thought to be relevant had been covered. For example, it was considered important to have a response to the following questions:

1. On good or reasonable land, after 30 years what are the returns from forestry in comparison to the returns from grazing?
2. Can you graze stock with trees and is agroforestry an option to consider?
3. Do trees have any effect on future sale of land?
4. Have you experienced troublesome shelterbelts or trees?
5. Do trees grow on your land?
6. What is your opinion about outside capital investment in forestry?
7. Do you like trees?
8. Did your father plant trees?

Each interview was examined by reference to the detailed notes made and by elaborating these notes, where necessary, when listening to the tape recording. For each interview there was thus a detailed but not a verbatim transcript. After each interview was studied a summary of the key points was drawn up. This summary included the level and type of tree planting, including absence of planting, then it listed the reasons followed by the constraints. Finally, a list of other relevant factors was made. The summary provided easy access to the main points of each subject's views on trees.

As the decision trees were being developed both the summary notes and the interview transcript were used to identify decision criteria, key factors and other constraints. The decision trees themselves evolved slowly as each interview was analysed. Early models were revised to make them consistent with later interviews. This process was difficult and time consuming. It required integrating each additional interview while at the same time developing, maintaining or modifying common themes. Early interviews were repeatedly re-examined to insure that the developing decision tree was consistent with them and the latest interview being considered. Some themes or elements originally considered important were discarded or modified in the light of integrating later interviews. At all times the trees had to fit the data of the interview.

Gladwin specifies that decision trees can be developed either sequentially, that is after each interview, or by examining all interviews after they are completed. The latter technique was used in this research and it worked well. The interviews were detailed and typically covered many aspects of tree decision making and related attitudes so that each interview recording and summary notes provided sufficient data to elaborate or test the decision criteria.

Following the development of four decision trees a return visit to the Hawkes Bay provided for refining the decision trees. A further seven interviews were conducted. This time an interview schedule was used to assess the decision criteria. Each decision tree was used to

prepare a separate schedule and each decision criterion was used to formulate a question. By working through the questions it was possible to assess what planting was, or was not occurring and for what reasons. Generally, the decision trees proved to be comprehensive and only a few additional criteria were introduced.

It must be noted that in formulating the four decision trees particular attention was given to what farmers said and thought about planting trees. Inevitably this entailed opinion, viewpoints or judgements about trees which reflected what the farmers believed. These perceptions could well differ from the perceptions of the professional forester. For example, the fundamental issue of whether trees grow on the farm (the first criterion in all four decision trees) is contentious because it involves a judgement about growth rates and acceptability of these rates. A professional forester may say that a slower than average growth rate is unsatisfactory and appraise a farm's tree growing potential as negative while the farmer may accept lower than average rates. Similarly, the issue of long-term returns from forestry is a complex decision for each farm and the professional forester might disagree with a farmer's assessment. However, the 'objective' assessment of these issues is not the point here because farmers will act according to their own assessment whether it is well founded or not. Thus, the decision trees represent farmers' perceptions of woodlot viability, for example, not the actual potential for woodlot forestry on those farms surveyed.

3.5 Limitations of the Method

The small sample allows for in-depth interviewing and developing a detailed understanding of farmers' decision making. It is not possible with the way the method is used here to draw conclusions about the farm population in Hawkes Bay. The total sample size is 25 and it is a non-random sample, even though attempts were made to select farmers with different types of farm and different parts of Hawkes Bay. At best the numerical data derived from the 25 cases is suggestive only of decision making in the farm population.

Gladwin (1989) describes how decision trees can be tested against another small random sample of people. In her examples these number about 40 cases. In this process the model is unchanged in the light of cases which do something other than what the model predicts. Predictions of 85-90 per cent of individual choices are considered acceptable. However, while this testing is useful in appraising a model and can show the proportions of farmers choosing particular decision criteria, it is problematic when it comes to making inferences to the population. Where there is a small and homogeneous population being studied a small sized test sample may be an acceptable basis on which to make inferences to the population. However, where the total population is large and diverse, as it is in Hawkes Bay, it is unlikely that a test sample of about 40 people is a good basis for population inference. This means the precise numerical indications of decision criteria from the cases used in the model may not represent the population.

Despite the limitation with inference to the population, the decision tree can still be important in itself. For example, in identifying particular combinations of decision criteria or constraints one can identify a particular approach to decision making. For people seeking to encourage tree planting or support farmers decision making this information can help them better understand the farmers they are dealing with. Some limitations with this decision making approach remain however. It would be a mistake to think that each of the decision trees presented here exhausts the analysis of decision making. For example, some of the

decision trees contain sub-decisions that could be examined with more detailed study than that provided for here.

Another limitation of the method lies in the scope of tree planting included. It was found that the most frequent plantings were trees for forestry, shelter, shade or drought fodder and these were the main focus of study. Not included were attitudes and actions regarding planting natives or trees for other practical purposes such as for pollen, nectar, nuts or firewood. While trees for these purposes are important to some people they remain outside the scope of this research.

CHAPTER 4

RESULTS

4.1 Introduction

The decision to plant trees is apparently a simple one, at least in terms of the action of planting trees. However, trees can be planted for different purposes, such as woodlots, shelterbelts or agroforestry, or poplar and willow poles can be planted for erosion control, shade or drought fodder. Because each of these situations is unique it is necessary to consider a separate decision tree for each type of planting. This chapter focuses on presenting four decision trees and provides some general observations before concluding with a summary and overview of results.

The models have some common features and we can consider these first before going on to examine each specific model. The models show that farmers must pass a set of elimination factors before they go on to consider planting trees. If any one of these factors is relevant the farmer will not consider the issue of planting trees. For example, if the farmer believes that trees will not grow on his or her land, then later parts of the model are irrelevant and the farmer exits early on in the model. The order of these elimination aspects is not particularly important. In this research the order reflects logical priority whereby apparently more fundamental criteria are covered earlier on, or where more extreme anti-tree cases are eliminated earlier. The models then identify important decision criteria regarding tree planting, and typically this introduces some judgement about cost and returns or benefits. After this the models divide farmers into different groups and more specific issues are examined. Finally, there is a list of constraints for those farmers deciding to plant, which, if any one is relevant, means that farmers will not plant trees. This three-part structure of elimination factors, reasons for or against planting and constraints that may apply, are common to each of the four decision tree models described here.

4.2 The Decision to Plant Woodlot Trees

The woodlot decision tree does not fit on to one page. Figures 2, 3 and 4 show the complete tree in its three main stages. Figure 2 shows the elimination aspects, Figure 3 the motivations for planting and Figure 4 the constraints on planting.

Figure 2 shows in parentheses the decision being made is to plant woodlot trees or not plant woodlot trees. There are three criteria which, if applicable, mean that the farmer eliminates him or herself from the decision tree. Farmers will not consider planting a woodlot if they believe that their land is unsuited to woodlot trees (criterion 1), if they have harvested trees and experienced low income and been put off woodlot trees (criteria 2 and 3), and if they have sufficient woodlot trees already (criterion 4). If any one of these factors is applicable then the farmer does not have to make a further assessment about planting woodlot trees.

Farmers not leaving the decision tree then go on to Figure 3 and criterion 5: the key decision about the assessment of the long-term returns from forestry compared to grazing. The issue was presented to farmers as a hypothetical issue concerning well managed trees on land of reasonable quality. This decision can in principle be based on rigorous accounting

Figure 2
Elimination Aspects of the Woodlot Decision

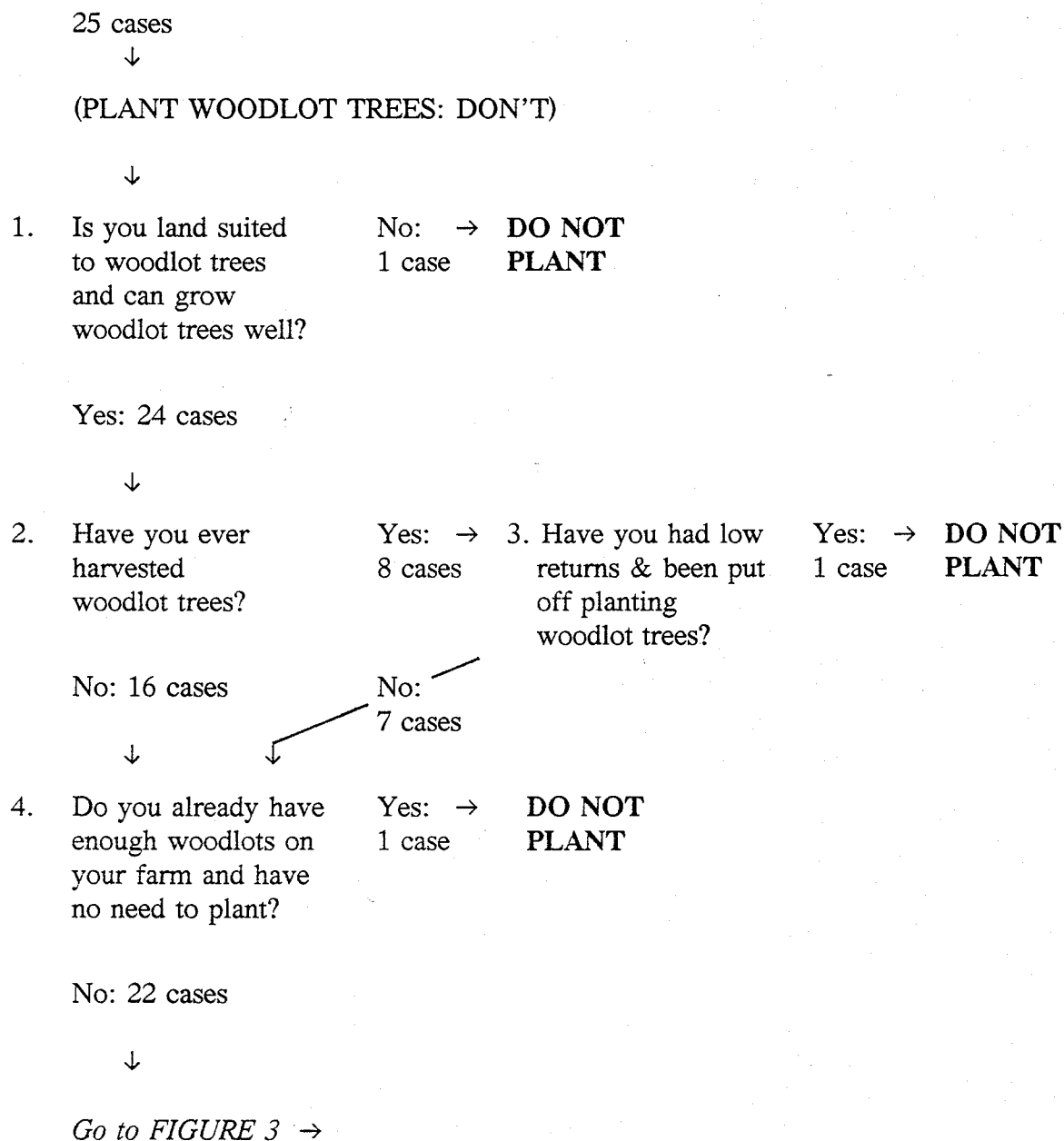


Figure 3 Motivation for Planting Woodlot Trees

(Given you've passed Figure 2 aspects)

22 cases
↓

5. Are the long-term returns from forestry greater than the returns from grazing, using the same type of land of reasonable quality?

Yes: 10 cases
↓

No: 12 cases
↓

Yes: ← 6. Do you need cash returns now anyway and will not consider planting woodlot trees?
2 cases
↓

DO NOT
PLANT

10. Is there a place for woodlots in your grazing system because they are the best land use for some of your land and this is your main reason for planting woodlot trees. →

Yes: 7 cases

No: 8 cases
↓

No: 5 cases
↓

Yes: ← 7. Is long-term income your main reason for planting woodlot trees?
5 cases

11. Are woodlots good for shelter and/or erosion and this is your main reason for planting woodlot trees? →

Yes: 1 case

No: 3 cases
↓

No: 4 cases
↓

Yes: ← 8. Are woodlots an integral part of farming aside from shelter and this is your main reason for planting woodlot trees?
2 cases

DO NOT
PLANT

(1 too old: 1 never really thought about it: 1 distance too far.)

No: 1 case
↓

Yes: ← 9. Are woodlots good for shelter and/or erosion control and this is your main reason for planting?
1 case

16 cases ←

↓

PLANT WOODLOT TREES UNLESS....

techniques but for farmers this approach is not an available or familiar way. Instead, for whatever reasons, they can make a decision even if it is a best guess. Farmers when interviewed were allowed to make this decision themselves understanding that different people have different views on this hypothetical issue. In only one case the farmer would not make a decision and the grazing option seemed the best reflection of his position. There is thus a basic division in the tree at criterion 5 reflecting the different assessment of forestry versus grazing returns. Broadly speaking there is a division here between forestry-oriented farmers and graziers. Now we can consider the decision criteria below this comparison of forestry and grazing returns.

Of interest now are farmers who either agree or disagree with criterion 5 but who still decide not to plant woodlot trees. There are two groups who make these decisions. One group agrees that forestry returns are greater than grazing but say they want or need the cash returns now and will not consider planting woodlot trees (criterion 6). The other group comprises those who favour grazing returns but then do not agree with either criterion 10 or 11 and so have no reason to plant woodlot trees. Farmers in this group mentioned that they were too old, that their farms were too far away or that they had never really thought about woodlots.

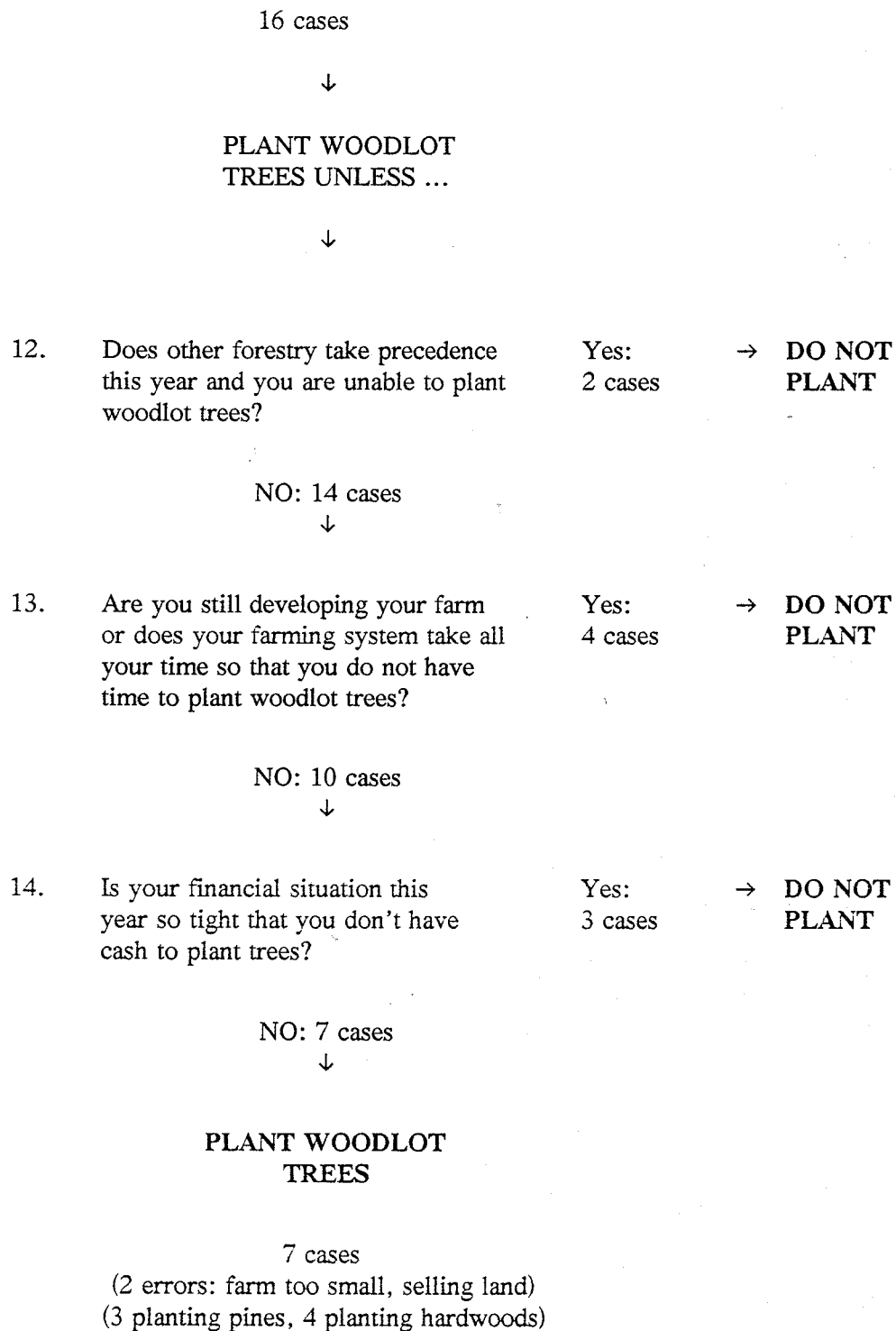
Now we can consider these farmers who have not eliminated themselves yet and who favour forestry returns over grazing returns. These farmers come down the left hand side of Figure 3. Criterion 7 identifies a group for which forestry returns themselves are the main reason for planting woodlot trees. Criterion 8 identifies a second group for whom, while expected forestry returns are greater than grazing, their main reason for woodlot planting is that forestry is an integral part of farming. These farmers define farming in terms of active forestry where trees are an essential part of their land use. They are familiar with the latest forestry techniques. Finally, criterion 9 identifies a group who plant woodlot trees mainly because of the shelter or erosion benefits.

There remain the group who have not eliminated themselves yet and who favour grazing returns over forestry. Criterion 10 identifies a group who see woodlots as the best use of some of their land. Criterion 11 identifies another group who use woodlots for shelter or erosion control.

Finally, we can consider the constraints to planting for those farmers who have motivation to plant woodlot trees. For the farmers who have a need or reason to plant woodlot trees it is not true that they will necessarily plant because the decision is subject to a number of constraints. Figure 4 lists the main constraints. Criterion 12 identifies farmers who would otherwise plant woodlot trees but do not do so this year because they are committed to other forestry activity, such as planting shelterbelts, agroforestry or poplars or willow poles. Presumably other forestry activity such as silviculture would also be a constraint but this was not mentioned by any farmers. Criterion 13 identifies a group which have no time to plant this year given their present system of farming or the stage of farm development. These farmers are likely to be committed to farming for the next few years. Finally, criterion 14 identifies a group of farmers who do not have cash available for this particular year and cannot afford any costs associated with planting.

Figure 4
Constraints for the Woodlot Decision

(Given you've decided to plant)



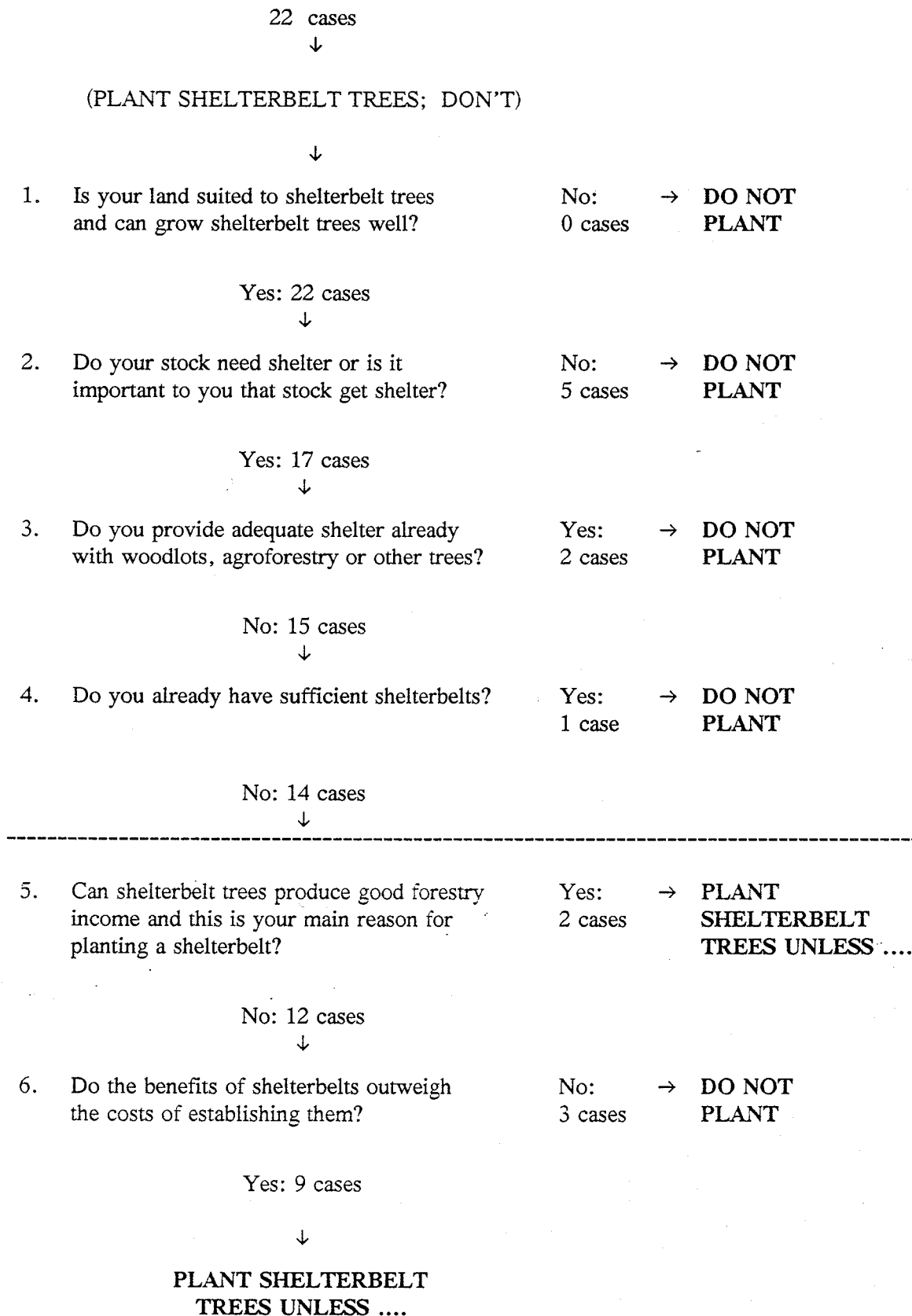
Results from the non random sample of 25 cases used to develop this woodlot decision tree model show that three farmers are eliminated early on in the decision tree. These farmers will not consider planting woodlot trees. The remaining farmers divide fairly evenly over the question of financial returns from forestry versus grazing with ten farmers favouring forestry and 12 farmers favouring grazing. A total of six farmers exit after this decision criterion because they want cash now or because they have no other reason to plant. This means that a total of nine farmers (3 + 6 or 36 per cent of the total sample) are not interested in planting woodlot trees and the remaining 16 (64 per cent) are interested in planting woodlot trees. For the remaining 16 cases the numbers show that for those favouring forestry returns, the financial aspect is important in their reasoning behind planting woodlot trees: of the eight cases going down this side of the tree five choose the financial criterion. For those favouring grazing returns most of them (seven out of eight) select the best land use criterion. However, despite the relatively large proportion favourably disposed to planting woodlot trees (16 cases out of 25) over one half are eliminated by a constraint. Figure 4 shows that of the 16 cases two (or 13 per cent) have other forestry taking precedence, four (or 25 per cent) have no time and three (19 per cent) have no cash. Together these nine cases do not plant because of a constraint even though they are favourably disposed to planting woodlot trees.

4.3 The Decision to Plant Shelterbelt Trees

Figures 5 and 6 show the shelterbelt decision tree. Figure 5 shows the elimination aspects and motivations for planting shelterbelt trees. There are four elimination criteria numbered one to four down as far as the broken line. Farmers will not consider planting shelterbelt trees if they believe that their land is unsuited to shelterbelt trees. It is unlikely that farmers will agree with criterion 1 and in the sample of 22 cases considered here there were no such cases. However, it is logically possible that a farmer will have this belief and the criterion needs to be included in the tree until a larger sample test shows otherwise. Moving down to criterion 2 shows that five farmers do not believe that their stock need shelter or should get shelter. This criterion is a good example of the subjective nature of the assessment of a criterion: in some cases the farmers' land and stock would, in this researcher's assessment, benefit from shelter and in some cases the farmers made a convincing case that their farms were not exposed to the wind. For a shelter enthusiast, all farms would benefit from shelterbelts. Criterion 3 covers the possibility that farmers are favourably disposed to shelter but obtain it from trees in forms other than shelterbelts. Two cases agree with this criterion and do not plant shelterbelts. Finally, criterion 4 covers the perhaps unusual situation where a farmer believes that the farm already has sufficient shelterbelts. Thus, after considering criteria 1 to 4 there are eight cases out of 22 (or 36 per cent) who will not consider planting shelterbelt trees, and most of these do not consider planting because their stock do not need shelter.

The remaining 14 cases go on to consider criterion 5 to see if forestry income is a motivation for planting shelterbelt trees. Two cases judge forestry income as important and would plant shelterbelt trees for this reason. For those not motivated by forestry income there remains the option of planting shelterbelt trees if there are other benefits which outweigh the costs. Criterion 6 covers this more demanding assessment, and the figure shows that there are three cases for whom, while they concede there may be benefits from shelterbelt, argue that on balance the costs outweigh the benefits. Typically, farmers are referring here to the cost of fencing, or that shelterbelt fencing is a very inefficient way of

Figure 5
Elimination Aspects and Motivations for the Shelterbelt Decision



Go to FIGURE 6

Figure 6
Constraints for the Shelterbelt Decision

(Given you've decided to plant)

9 cases



**PLANT SHELTERBELT
TREES UNLESS ...**



- | | | | |
|----|--|-----------------|---------------------------|
| 7. | Does other forestry take precedence this year and you are unable to plant shelterbelt trees? | Yes:
2 cases | → DO NOT
PLANT |
|----|--|-----------------|---------------------------|

NO: 7 cases



- | | | | |
|----|--|-----------------|---------------------------|
| 8. | Are you still developing your farm or does your farming system take all your time so that you do not have time to plant shelterbelt trees? | Yes:
2 cases | → DO NOT
PLANT |
|----|--|-----------------|---------------------------|

NO: 5 cases



- | | | | |
|----|---|-----------------|---------------------------|
| 9. | Is your financial situation this year so tight that you don't have cash to plant trees? | Yes:
0 cases | → DO NOT
PLANT |
|----|---|-----------------|---------------------------|

NO: 5 cases



**PLANT SHELTER BELT
TREES**

1 error (selling farm)
(2 planting pines, 2 planting hardwoods)

fencing a space for trees. The outcome of putting all 22 cases through this first part of the shelterbelt decision tree is a total of nine cases (or 41 per cent) who will plant shelterbelt trees unless they face a constraint to planting.

Figure 6 enumerates the constraints to planting shelterbelt trees and these are the same as in the earlier decision tree for the decision to plant a woodlot. There are two cases where other forestry takes precedence (criterion 7) and two cases where there is lack of time because the farm is still being developed or because of the management system being used (criterion 8). For this decision tree there are no cases constrained by lack of money but this is purely idiosyncratic and it is likely that this is a major constraint to shelterbelt planting. Finally, there are five cases that the decision tree predicts would plant shelterbelt trees but one of these was an error for the case where the farmer was intending to sell his farm. Of the four who did plant, half planted pines and half planted hardwoods.

4.4 The Decision to Plant Agroforestry Trees

Figures 7 and 8 show the agroforestry decision tree for agroforestry defined as wide-spaced timber trees on land of good or reasonable quality. For most of the farmers interviewed this was thought of as typically pines only. Figure 7 shows the elimination aspects and motivation for planting agroforestry trees. As in the earlier trees there is the issue of whether trees can grow, and there are two cases who assess this issue in the negative. Criterion 2 then can be considered and relates to those farmers, two in this sample, who have not heard about agroforestry and for this reason have not considered it on their farm. This criterion is difficult to appraise because simply asking this question of a farmer is unlikely to be answered negatively even if the farmer has not heard about agroforestry. In the course of interviewing it is possible to make an assessment indirectly. Criterion 3 was relevant to four farmers who had heard about agroforestry but were quite uncertain about it. They were waiting to see how it would turn out and in the meantime were quite keen on other types of tree planting. Finally criterion 4 relates to the economic assessment of agroforestry. There were 13 cases who did not like the economics of agroforestry. Of the 13, two did not specify exactly why it was uneconomic, nine said that grazing land was best for stock and two pointed out that stock and trees do not mix. At this point there was reference to stock poisoning and lack of grass growth under trees. Some farmers with deer found or believed agroforestry to be impossible. The outcome of putting 25 cases through the first part of the decision tree is a total of four cases (or 16 per cent) who will plant agroforestry trees unless they face a constraint to planting.

Figure 8 enumerates the constraints to planting agroforestry trees. There are two cases where other forestry takes precedence (Criterion 5) and no cases where there is lack of time (criterion 6). Perhaps farmers have found reasons for not planting before getting to this constraint. Finally, there is one case constrained by lack of money leaving one case that the decision tree predicts will plant agroforestry trees. In this case the trees were pines and eucalypts.

Figure 7
Elimination Aspects and Motivation for the Agroforestry Decision

25 cases



(PLANT AGROFORESTRY TREES; DON'T)



- | | | |
|---|----------------|-----------------------|
| 1. Is your land suited to agroforestry trees and can grow trees well? | NO:
2 cases | → DO NOT PLANT |
|---|----------------|-----------------------|

Yes: 23 cases



- | | | |
|--|----------------|-----------------------|
| 2. Have you heard about agroforestry and considered it on your farm? | NO:
2 cases | → DO NOT PLANT |
|--|----------------|-----------------------|

Yes: 21 cases



- | | | |
|---|-----------------|-----------------------|
| 3. Do you need time to evaluate agroforestry for your farm, are uncertain, and would prefer other forestry first? | YES:
4 cases | → DO NOT PLANT |
|---|-----------------|-----------------------|

No: 17 cases



- | | | |
|---|------------------|-----------------------|
| 4. Do you think agroforestry is uneconomic because grazing is best for stock, and/or because stock and trees don't mix? | YES:
13 cases | → DO NOT PLANT |
|---|------------------|-----------------------|

No : 4 cases



**PLANT AGROFORESTRY TREES
UNLESS....**

Figure 8
Constraints for the Agroforestry Decision

(Given you've decided to plant)

4 cases



**PLANT AGROFORESTRY
TREES UNLESS ...**



- | | | | | |
|----|---|-----------------|---|-------------------------|
| 5. | Does other forestry take precedence this year and you are unable to plant agroforestry trees? | Yes:
2 cases | → | DO NOT
PLANT |
|----|---|-----------------|---|-------------------------|

NO: 2 cases



- | | | | | |
|----|---|-----------------|---|-------------------------|
| 6. | Are you still developing your farm or does your farming system take all your time so that you do not have time to plant agroforestry trees? | Yes:
0 cases | → | DO NOT
PLANT |
|----|---|-----------------|---|-------------------------|

NO: 2 cases



- | | | | | |
|----|---|----------------|---|-------------------------|
| 7. | Is your financial situation this year so tight that you don't have cash to plant trees? | Yes:
1 case | → | DO NOT
PLANT |
|----|---|----------------|---|-------------------------|

NO: 1 case



**PLANT AGROFORESTRY
TREES**

(No errors)
(pines and eucalypts)

4.5 The Decision to Plant Poplar or Willow Poles

Figures 9, 10 and 11 show the poplar or willow decision tree. Figure 9 shows the elimination aspects and motivations for planting poplars or willows. Criterion 1 covers the issue of whether in fact they do give benefits of any kind and there are two cases who see no benefits and decide not to plant. Criterion 2 covers those three cases which while agreeing that poplars or willows can provide benefits say they have no need for any of the benefits. Criterion 3 was relevant to four cases where the farmers said that they had sufficient poplars and willows. This is a reasonable position for some farmers because planting of this type has been done for at least 20 to 30 years. A farm of modest size on which active planting of poles occurred early on would now have many trees in erosion-prone areas. Finally, criterion 4 relates to the economic evaluation of costs and benefits from planting poplars or willows. The typical way of establishing them is to plant large poles with protective plastic sleeves. The poles may be from 50 to 100 millimetres in diameter and long enough to be securely rammed into the soil and protected to a height of 1.7 metres. In 1992, the poles cost from \$3.00 to \$4.00 each, and the sleeves cost \$1.87. There is now no Catchment Board subsidy on poles. The cost can be reduced by growing one's own supplies in a nursery on the farm. Some farmers used other protectors such as drums, and others kept stock out for a season or two until the trees were established. With any method of establishment there is a cost involved and this is what the farmer has to weigh up against the benefits. Figure 9 shows that there is one case where the farmer makes a negative assessment of the benefits. This was because the farm was located in a dry area and, while erosion did occur, the trees died some years after establishment. There remain 13 cases who will plant poplars or willows to obtain a benefit.

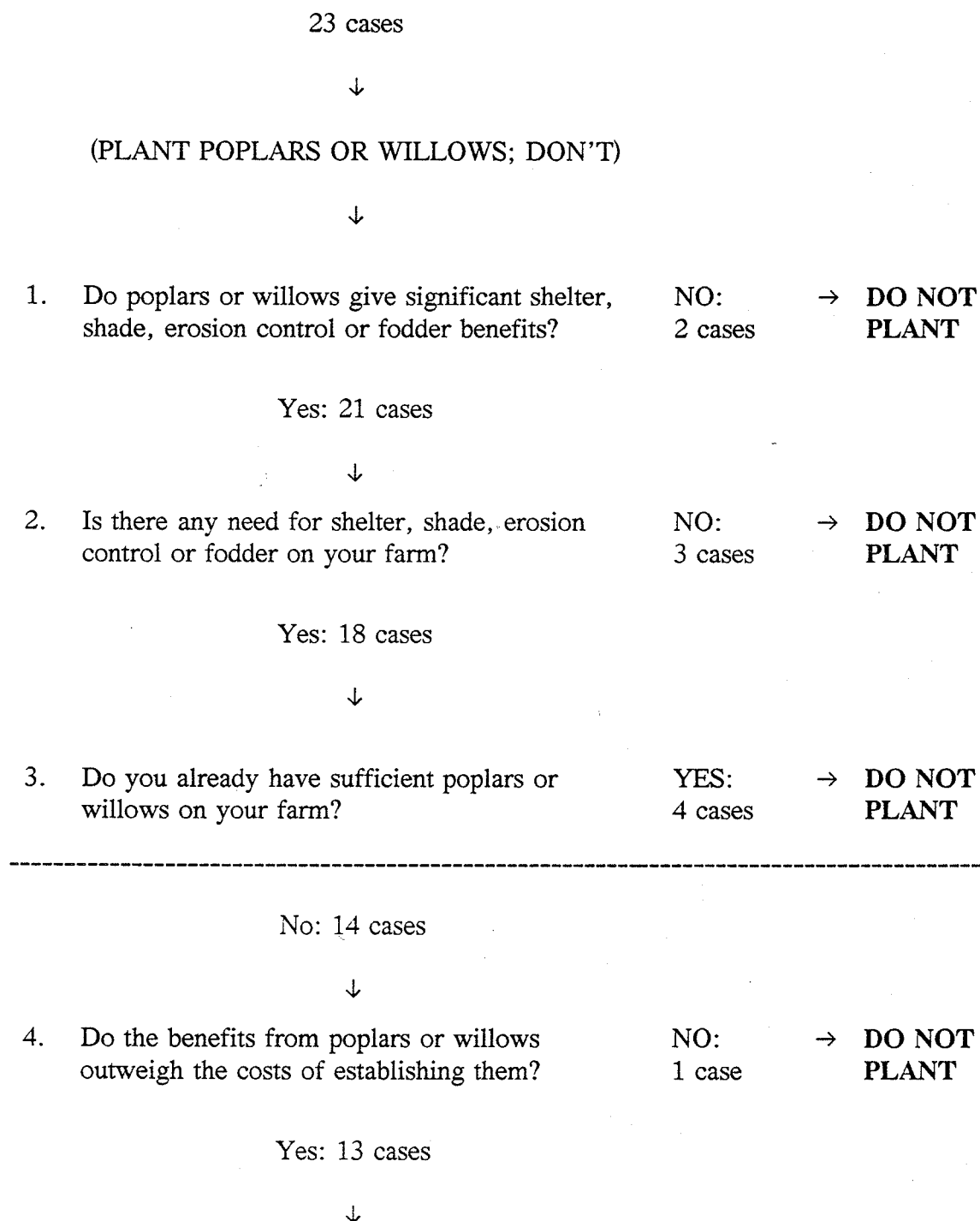
While poplars and willows may be planted it is relevant to examine further the specific motivations for planting and Figure 10 shows the three main reasons given. Some farmers see poplars or willows mainly as erosion control and Criterion 5 covers this viewpoint. There are six cases where erosion control is the main reason, while there are two cases where both protection of land and stock is favoured. During the interview this issue was carefully probed and there was no doubt that both benefits were ranked equally. However, there were five cases where shelter and/or shade were favoured and of these criterion 6 identifies those three cases preferring shelter and/or shade and two cases preferring fodder.

Finally Figure 11 shows the constraints applying to all 13 cases who decided to plant poplars or willows. There is one case where other forestry takes precedence (criterion 7), three cases where there is lack of time (criterion 8), and two cases where there is lack of money leaving seven cases who plant.

4.6 Some General Findings

Some factors thought to be relevant to decision making did not emerge as significant in this pilot study. For example there is the issue of what role if any did the farmer's father played in encouraging tree planting. It was found to be unimportant as the tree planting farmers had fathers which were positive and negative examples of forestry. The question whether farmers liked trees drew a fairly universal response: very few farmers are likely to speak against trees. On another topic, farmers generally are not keen on using outside capital to overcome financial constraints typically because they do not like the associated lack of control.

Figure 9
Elimination Aspects and Motivation for Planting Poplars or Willows



Go to FIGURE 10

Figure 10
Motivations for Planting Poplar or Willows

(Given you've passed Figure 9 aspects)

13 cases

↓

- | | | |
|---|------------------|------------------------------------|
| 5. Is protection of land more important to you than protection of stock (shelter, shade, fodder)? | Yes:
6 cases | → PLANT FOR EROSION CONTROL |
| | Both:
2 cases | → PLANT FOR BOTH |

NO: 5 cases

↓

- | | | |
|---|-----------------|---|
| 6. Is shelter and/or shade more important to you than drought fodder? | Yes:
3 cases | → PLANT FOR SHELTER AND/OR SHADE |
|---|-----------------|---|

NO: 2 cases

↓

PLANT FOR FODDER

13 cases

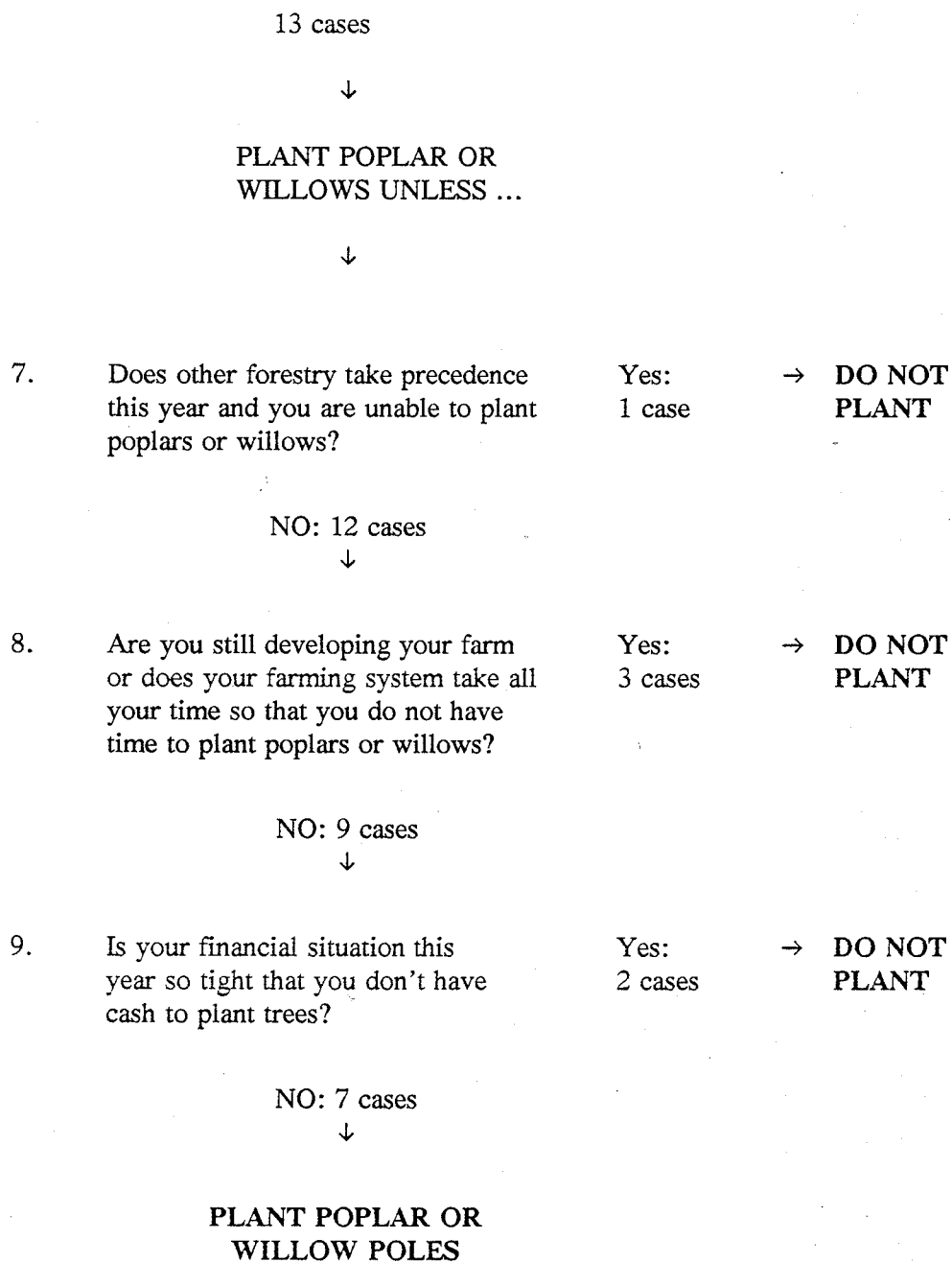
↓

**PLANT POPLAR OR WILLOWS
UNLESS**

Go to FIGURE 11

Figure 11
Constraints for the Poplar or Willow Decision

(Given you've decided to plant)



(No errors)

In general, the attempts to find two groups - one of farmers who were planting and one of farmers who were not planting - proved very difficult. For the group of 25 farmers interviewed, and for others considered and not interviewed, it was hard to find farmers not interested in planting trees. This observation was supported by other Hawkes Bay people in MAF, a Federated Farmers representative and farmers in general. There is a thorough interest in trees among many farmers and this is supported by observations of demand for planting stock which for the 1992 season show strong demand.

Some farmers overcome the cost constraint by finding cheap ways to establish trees. For example, many farmers planting poplars or willows on a regular basis have their own nursery to supply poles. This is a saving of from \$3.00 to 4.00 each (depending on size). The soil conservator at Wairoa reports that the sale of protective sleeves for poles has increased greater than the rate for poles. One farmer buys low cost drums to protect poles. For other trees, one farm had its own seedling nursery to reduce the cost of seedlings. Some farmers have the ability to use electric fences to provide the needed protection and overcome the cost of fencing (one of the major costs).

Clearly apparent from the interviews was the variable knowledge of forestry and tree planting and management exhibited by the farmers. Some farmers did not know that forestry expenses were tax deductible. Some farmers found that they could not establish poles with cattle while others did routinely. Often, it is the experience of starting to plant that is daunting because the first year's poles attract attention from stock. After many years of planting, the addition of new poles is not so significant to the stock. The results from the agroforestry decision tree show that many farmers are unfamiliar with the evidence supporting it and they are quite uncertain about its potential.

4.7 Conclusion: Summary and Overview of Results

All four decision trees have a common structure. Farmers avoid making a decision about trees if they are eliminated early on in the decision process. The elimination aspects for all trees are listed below:

- believe that trees do not grow
- have been put off because of low income
- believe that stock do not need shelter
- have shelter from other trees
- have never heard of agroforestry
- are uncertain about agroforestry
- believe poplars and willows do not give benefits
- have no need for benefits from poplars or willows
- already have sufficient trees (of each type).

These factors cover a range of beliefs about trees, and if they apply the farmer eliminates him or herself from the tree.

Farmers not eliminated from the tree go on to consider a key decision about planting. For woodlots this starts with a comparison of forestry and grazing returns and then goes on to consider separate main reasons for planting, such as income, shelter, best land use or integral land use. For shelterbelts it is a relatively simpler decision about the benefits and costs for

these farmers who do not plant shelterbelt trees for forestry income. Similarly, for agroforestry the key issue is an assessment of the economics of agroforestry versus grazing. Presumably, farmers favouring agroforestry also judge woodlot forestry returns to be greater than grazing returns. Finally, the poplars or willows decision rests on an assessment of the benefits and costs but includes evaluation of what is in need of protection.

While the decision trees identify groups of farmers who would plant, it also identifies why some who would like to plant are constrained from planting. For all decision trees the constraints are identical, namely: other forestry taking precedence, lack of time and lack of cash for this financial year.

Table 5 summarises some characteristics for all four decision trees. The number of cases varied for each type of decision because a few interviews were not comprehensive. Comparing each type of decision shows that there were fewer cases with an elimination factor in the woodlot decision. This suggests that woodlots compared to shelterbelts and agroforestry are familiar to farmers so that a greater percentage go on to consider the planting decision. However, while many do consider the woodlot decision and have a reason to plant there are nine who were constrained. This is the largest number constrained in any decision tree. For the other decision trees there were more farmers who chose an elimination factor and for them the shelterbelt, agroforestry or poplar or willow decision was not an issue. As noted in the results, for the agroforestry decision there is a large number who did not have a reason to plant. The poplars or willows decision has similar features to shelterbelts and agroforestry up to the point where reasons to plant are relevant and there is only one such case. Thus for poplars or willows, a large number will plant trees unless constrained and since fewer are constrained than for the woodlot decision the largest number (seven) decide to plant.

Table 5
Summary of Decision Data for the Four Decision Trees

	Total Number of Cases	Number with Elimination Factor	No Reason to Plant	Sub-Total: Plant Trees Unless ...	Number Constrained	Total Deciding to Plant (excluding errors)
Woodlot	25	3	6	16	9	5
Shelterbelts	22	8	5	9	4	5
Agroforestry	25	8	13	4	3	1
Poplars or Willows	23	9	1	13	6	7

A common dimension to all decision trees is the set of constraints. For all four decisions there were seven cases where other forestry took precedence, nine cases where there was lack of time and six cases where there was lack of money for this financial year. It is possible that the first constraint would not apply quite soon so that in a year or two the farmer could switch to that option. It is possible that if the farm financial situation improved the second constraint would not apply and farmers would then plant. More slow to change would be the lack of time constraint because this relates to the medium-term objective of developing the farm.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Introduction

The literature review in Chapter 2 shows that farmers emphasise a variety of reasons when choosing to plant trees, including shelter, best land use and aesthetics as important reasons for planting. Income from forestry is ranked lower in importance than these other reasons, and farmers said they do not plant because it takes land out of production, they lacked money or there was inadequate return. Typically, surveys resulted in aggregated scores or rankings for particular reasons for planting trees. Only a few studies have been done recently after the flourish of results in the mid-1980s, so there is a need to begin updating the research, to extend it and to see if farmer attitudes are changing. The present research applied a new method to a familiar problem and sought to show up decision criteria important to farmers when deciding to plant woodlots, shelterbelts, agroforestry, or poplars or willows. The ethnographic decision tree model was applied to a small, non random sample of farmers in Hawkes Bay by way of a pilot study. The results comprised four distinct decision trees which identified particular combinations of reasons for the decision to plant or not to plant trees.

This chapter builds on the summary provided at the end of Chapter 4 and begins by comparing these results with earlier research. It then discusses some general observations about decision making before discussing implications for policy and future research.

5.2 Comparison of Decision Tree Results to Earlier Research

The highlighting of farmers' decision making processes is a unique contribution to forestry research. The existing literature presents results which are typically aggregated for all farmers studied and typically overlook variations within the group. The results presented here clearly show particular combinations of reasons for and against planting. For example, for the woodlot decision there are four basic groups. The first group do not even consider planting woodlot trees because they believe trees will not grow, they have been put off or they already have enough woodlots. The second group are graziers who can find no reason to plant. The third are graziers who plant woodlots typically because they are a better land use on some of their land. The fourth group see forestry as providing better return than grazing and for most of this group the financial returns are the main factor in their decision to plant. Further, the decision trees explicate many of the details of the decision making process. In particular, the results identify four different decision making processes. While these may be closely related it is useful to consider each separately in any attempt to understand tree planting decisions. Research that focuses on attitudes to trees overlooks how these will differ depending on their purpose.

The results presented here corroborate some of the earlier findings. For example, New Zealand research has shown that lack of time and lack of money are frequently cited by farmers as the main reason for not planting trees, and these are the essential elements of two of the constraints identified here. Identified in this research is the constraint of other forestry activity. The earlier national surveys of farmers found that taking land out of grazing was

the most frequent or most important reason for not planting. The results of this study show that this is a key element of the economic assessment of planting trees, but it is not uniformly assessed by all farmers.

The results of the research presented here also indicate what the farmers studied have actually done for the winter season of 1992, rather than indicating a general attitude to trees. The summary of decision data in Table 5 shows that five farmers out of the 25 sampled (20 per cent) say they are planting woodlot trees this winter season. Roughly similar percentages were found for shelterbelts (23 per cent) and poplars and willows (30 per cent) but only one farmer (four per cent) was planting agroforestry trees.

The results from the four decision trees seem to indicate that economic factors are important in all decisions. This finding appears to be at odds with the literature which shows that non economic factors are important in farmers decisions to plant trees. However, the literature does report that farmers say lack of money is a major constraint to planting. This means that financial questions are important in the decision making process and the decision trees spell out precisely how this occurs. In particular the results here confirm that economic factors play a significant part in farmers' decision making regarding planting trees even though financial returns from trees may not always be significant as a motivation to plant. It may also be that the earlier surveys underemphasise the role the economic factors play in farmers' attitudes to trees.

However, it is possible that the present situation is different for farmers and that they are now more concerned with economic and financial matters. Farmers in New Zealand have had to reappraise their land use decisions in the absence of subsidies supporting particular land uses. There is clear evidence of changes in land use (Fairweather, 1992). Further, there is evidence of improving forestry returns compared to pastoral returns (Levack, 1991) which have been at relatively low levels in recent years. It is likely then that farmers are considering tree planting alternatives but are having to appraise the decision carefully on largely economic grounds. Perhaps also there has been a long-term process at work whereby there is increasing recognition of forestry. In the 1980s the researchers were aware of farm forestry potential and did relevant research and now in the 1990s the ideas have spread beyond the researchers to the farmers. Increasing financial awareness is being matched by environmental awareness. In March 1988 Cyclone Bola caused massive damage in nearby Gisborne, thereby reminding farmers in Hawkes Bay, and elsewhere, of the importance of trees on farms. The issue of possible change in attitudes can only be addressed by way of large surveys and the indications here are only suggestive.

The results here, when compared to the existing research, show up a different emphasis to aesthetic reasons. The New Zealand research to date shows clearly that farmers rate aesthetic reasons as important in their attitudes to planting trees. The results reported here in the four decision trees do not give any recognition to aesthetic reasons. However, in the interviews aesthetic reasons were emphasised and in discussions many of the farmers said that the aesthetic benefits from trees (i.e., for beauty or for improving their work environment) were important. However, they made this statement as they were listing the reasons for or benefits of planting trees. In no cases were aesthetic reasons given as the sole or main reason for planting. Because only the main reasons were adduced from the interviews, the aesthetic reason dropped out. If this interpretation is valid then it means that while aesthetics are a factor in farmers' decision making it is not a decisive factor. Perhaps

when farmers plant trees and there are no clear cut immediate or even long-term financial benefits they rationalise their decision in terms of shelter and aesthetic benefits. These are obvious and more quickly gained benefits which farmers can point to to support their decision to plant. If this process does occur it would explain the high rankings given to aesthetic benefits in the attitude literature. It would also explain the lower rankings given to economic factors.

5.3 Selling Land, Rationalisation and Farm Size

The decision tree method entails paying attention to what farmers say and a number of hitherto unmentioned points deserve comment. These include the case where a farmer intended to sell his farm, the rationalisation process, and a recurrent theme regarding size of farm.

One of the errors in the decision trees is derived from one case where the farmer was very favourably disposed to woodlot planting but decided not to plant because he intended to sell the farm. This was an idiosyncratic factor among the sample of farms used so it was not included as a decision criterion. However, since there is a small but significant turnover of farm land in New Zealand, perhaps it is a factor worth considering as important in tree planting decision making. Thus, it may be that farmers favourably disposed to trees may choose not to plant for fear or concern that they will move in future and not get the benefit of the trees. Impinging on this factor are the farmers' expectation regarding the presence of trees on the farm for land that is to be sold. The interview data showed a range of views on this topic. Some farmers thought that the value of trees was not recognised at the point of sale while others thought that it was and that trees can help sell farm land. The view of one commentator perhaps sums up the situation: "farms with trees have increased saleability if not an increase in value". Most farmers interviewed thought trees on farms were favourable when it came to selling.

Against this consideration of future sale values is the fact that while a certain proportion of farmers who will in the near future sell and move, many will not know beforehand that they will in fact have to move. If this is the case then they will make decisions assuming that they will be farming that land indefinitely.

The issue of rationalisation was discussed briefly above when it was suggested that aesthetic reasons were emphasised to justify the decision to plant. Raising the issue of rationalisation in decision making leads to an observation on the linear nature of decision trees. The decision trees imply a logical order of thinking which may be deceptive. While it makes sense for us to interpret farmers' decisions in a sequential fashion, this can be a true representation but at the same time a distortion. It does not mean that the origin of farmers' thinking follows this same pattern. For example, farmers may like trees for some unknown reason as an initial starting point and then examine criterion 4 in Figure 2 regarding long-term returns from forestry versus grazing. In so doing they find the positive assessment more acceptable and so come to that decision because of their preferred end point. Thus, in terms of the origin of the actual decision making process, the order of the criteria may be quite different from the logical order portrayed in the decision tree. Thus it may be that for some farmers the particular reasons chosen for planting or not planting are a rationalisation of a preferred viewpoint.

The process of rationalisation was quite obvious during the interviewing when farmers would find or assert positive or negative attributes to trees depending on their basic position. For example, for graziers, pine shelterbelts can be viewed negatively because they promote livestock disease, cause abortions, sour the ground or cause endless maintenance problems. For farmers who like trees they can be viewed positively as providing shelter, beauty or timber. In a similar way the forestry enthusiasts would find many reasons to support their decision to plant. As a general observation the more enthusiastic farmers were about trees the more reasons they identified for planting trees. This factor led to multiple reasons being given for planting and meant that the main reason had to be identified to use in the decision trees.

Many farmers emphasised that if they had a larger farm they would plant more trees. What they meant by this was if their financial position was sounder, or they were prepared to forego some pastoral returns, they would be able to plant trees. It cannot be seen as a farm size factor because lack of size was mentioned by farmers with 200 hectares and by farmers with 2,000 hectares.

5.4 Comments on the Ethnographic Decision Tree Method

Gladwin (1989) clearly specifies that all decision criteria have discrete yes or no outcomes and this allows the tree to be built up to identify decision criteria. However, in some cases it was possible to have more than one outcome. For example, with the poplar or willows decision tree at criterion 5, for the question relating to protection of land versus protection of stock, there were yes, no and both answers. This was the only point at which multiple options occurred so it was not significant in this application of the method. However, this occurrence does raise the question of the suitability of yes and no outcomes for some decision trees.

Another minor point about this method needs to be emphasised. Even though a positive decision to plant is made the number of trees planted may be quite small and the method does not handle this dimension very well. For example, a farmer may decide to plant trees for shelter but only plant 20 pine trees which would amount to an insignificant contribution to the pool of trees. This problem could perhaps be overcome by setting a limit below which the case was considered as equivalent to not planting. Such a process was not used in this study. The problem is not really significant since this report is a pilot study and is preparatory to a random sample survey at which point an accurate assessment of number of trees planted can be made.

5.5 Implications for Policy

For this discussion the assumption is made that encouraging trees of all forms and types on farms is a desired goal. The purpose of this discussion then becomes one of identifying the ways this goal can be achieved. Before addressing this issue it is important to note some more general observations first.

The pro-tree assumption of this discussion is appropriate for the current situation in Hawkes Bay. As noted in the results there appears to be widespread interest in trees from many farmers. Even though the sample of 25 farmers used here is small and not representative, the clear majority of farmers sampled had positive attitudes to, and interest in, trees in all

their forms. In addition, other people consulted in the conduct of the research also thought that there was widespread interest in trees.

A major factor inhibiting tree planting is the operation of three main constraints. Many farmers said that they faced a financial constraint to planting trees. Some faced a cash shortage this year while others lacked time to plant. It is tempting to think that financial incentives would be useful in encouraging tree planting. However a number of considerations make this policy less than desirable. First, the prevailing ethos generally is not to provide subsidies or supports and this is widely accepted by farmers. Invoking a different policy for trees would run counter to the current way of operating and cause confusion. Further, as anti-subsidy proponents would argue, subsidies distort and with trees this could lead to hasty planting and poorly managed trees. Second, there is already tax deduction provision for expenses relating to planting trees on farms and these go a considerable way in easing the financial burden of planting when the time to return is long. Clearly evident from the interviews was lack of awareness of this financial incentive and much could be done by tree proponents to ensure farmers know about current tax deductions. Third, the fact that tree planting and management entails some financial costs is desirable in that it disciplines tree planting development. Farmers should know what trees and materials cost. It also encourages farmers to develop cheaper ways of planting. Some farmers interviewed had overcome the costs of establishing trees by making cheap tree protection from drums, growing their own trees or poles or using electric fencing. Those farmers who had a strong interest in trees were more likely to seek out lower cost alternatives.

The decision trees presented in this report clearly show what farmers believe to be the case regarding trees of all main types on their farms. The important point is the role played by beliefs. There is room for debate on many interpretations farmers have about trees on farms. The question of whether trees grow on farms invites comment about which species the farmer is considering in making the assessment. The question of whether a farm needs shelter invites comment about the potential of shelterbelts, for example, even on a farm that is apparently well sheltered. Forestry advisors must be prepared to challenge these farmer beliefs and devise ways of effectively communicating alternative viewpoints. Ultimately, it is debate that will provide information that allows farmers to develop a more informed view. Debate will surely be involved because even forestry and tree experts have beliefs which vary and these constitute different expert viewpoints on trees. An informed challenge to farmers' beliefs must recognise that the forestry and tree advice is itself evolving.

People who work with farmers and are trying to encourage tree planting can note a number of suggested strategies relating to farmer advice. These suggestions in no way imply that present advisors are unaware of these points. At no point in the research was any attention focused on the role of advisors. These points are suggestions which, even if they cover familiar ground, will at the least, confirm what advisors already believe.

Advisors have a number of strategies in the light of the structure of the decision trees. The first strategy is to focus on farmers who eliminate themselves from considering the hard questions about planting trees. These elimination factors are shown in Figures 5, 7 and 9 and include such beliefs as 'trees do not grow', 'stock don't need shelter', 'have not heard about agroforestry' or 'poplars and willows don't give benefits'. Farmers agreeing with these propositions could be targeted with information which specifically addresses these issues.

The second strategy relates to the next stage of all the decision trees in which economic costs and benefits are assessed. At this stage farmers are at least considering trees and would value information on costs and returns. As noted earlier some farmers are not aware of deductions for expenditure or ways of decreasing establishment costs. Some farmers think of pines when trees are being discussed and are unaware of alternative species and the expectations that they have for higher returns. The idea of producing forestry income from shelterbelts was appreciated by only two cases, and the potential of agroforestry is not widely recognised at all.

The third strategy relates to the constraints and these are essentially lack of time and lack of money. The focus of advisors could well emphasise techniques for minimising costs and for planting and managing trees in ways that minimise time requirements. Perhaps little can be done for those farmers facing a shortage of cash in this financial year. However, for the remaining farmers there is scope for suggesting ways of planting trees that do not take large amounts of time or money.

Some more specific points can be made for advisors by reference to the key points of each decision tree. For the woodlot decision there is a need for good information on the comparison of returns from grazing and from forestry. For the shelterbelt decision there is need for information on the benefits of shelter. For the agroforestry decision there is need for general information about agroforestry and for the case to be made that agroforestry can be practised with grazing for improved economic returns. The poplars or willows decision tree suggests that farmers do not need much persuasion as to the merits of planting them.

A final strategy relates to technical expertise. Some farmers are now considering trees but their productive experience relates to livestock and pasture. There are farmers unaware of forestry and silvicultural practices and there is much scope for helping farmers learn the new techniques associated with the variety of options for management of trees on farms. Perhaps farmers' lack of familiarity with forestry techniques leads them to overestimate the costs and time involved.

Since the current tree research in Hawkes Bay is with poplars and willows some specific comments are relevant to the goal of encouraging farmers to plant them. Generally, farmers appear to be very much aware of the benefits of poplars or willows. It is with these trees that the widespread and favourable attitudes to trees are most noticeable and for which the positive attitudes are manifest. It is likely that Cyclone Bola has had long-term and beneficial impacts on this region. What remains then is a need on some farms for better management to get trees established. Some farmers reported that they could not get poles established because they run cattle, while other cattle farmers were successfully establishing them. Some farmers observed that initial plantings were eaten by stock but as they number of trees increased, the stock became more tolerant. It follows that farmers should be encouraged to keep planting to get passed the point at which trees are novel for stock. Since farmers appear to be favourably disposed to poplars or willows it is likely that research findings which can inform farmers' management will be well received. Documenting leaf fodder production from trees would help establish stock carrying capacity or needs for tree planting. Production data from different species would provide farmers with alternative trees to consider. However, since poplars or willows are planted mainly for erosion control by some farmers there is some scope for increasing awareness of fodder benefits. In general, the results of this research suggest that farmers will be receptive to research findings relating to fodder species.

5.6 Implications for Future Research

An important topic of future research is testing the models developed and presented in this research report. Gladwin (1989) argues that testing can be done by interviewing another small sample and seeing how well the decisions predicted by the model are borne out in reality. This test sample is meant to be a close match to the population so that, while small, it is a representative sample. Given the large and diverse nature of farms in Hawkes Bay it is unlikely that a small sample would represent the population adequately, so interviewing would not be best for testing in terms of representation. If a small sample could be found that would represent the farm population then interviewing would be satisfactory and would allow for accurate documentation of farmers' responses to the decision criteria. Since the results of this research are based on a small, non random sample it is important now that a random sample survey be undertaken. Such a survey would enable confident inference to the farm population as a whole. Specifically, it would then be possible to document the numbers on each part of the decision trees and to know more precisely how farmers are deciding to plant or not to plant trees. Further, a mail survey of a large random sample would facilitate comparison of the current situation with the mid 1980s when the last New Zealand-wide survey was done. This comparison would be timely and show up any change in farmers' attitudes over the interviewing decade.

Other research needed is to refine some aspects of the decision trees themselves. For example, while the core decision for the woodlots seems straightforward, the core decision for the shelterbelts seems to contain a complex decision in itself. What is going on when farmers decide that the benefits of shelterbelts do, or do not, outweigh the costs of establishing them? Perhaps further interviewing would yield a separate decision tree on this issue.

Another aspect of the decision processes that could be examined is the decision making for the choice of tree planting, that is, between woodlots, shelterbelts, agroforestry and poplars and willows. It is likely that the more familiar technology is preferred. The present research does not directly address this comparison decision but instead arbitrarily includes all four as separate decision trees. An attempt to develop a decision tree that integrated all four types of planting proved to be unsuccessful because it introduced additional complexity. Clearly, the four separate trees needed to be understood first. Perhaps there is a decision process at work in the choice between different planting options that can be mapped out with further research which addressed this specific issue. Another topic not adequately addressed is the role of aesthetic benefits for planting trees. As noted in the results, these were frequently mentioned but do not play an important part in any decision tree. Further interviewing might elucidate this aspect of farmers' attitudes to trees.

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