Understanding why farmers plant trees

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Author's Note
The research reported here was conducted in 1992 and is now slightly dated. It is presented in the belief that it is still relevant, and because it provides wider appreciation of this kind of research than that obtained from its publication as an AERU Research Report.

Abstract
Farmers' attitudes to trees are well covered in the literature but it does not directly examine farmer decision-making. Research conducted in 1992 is reported in this article and used to show how decision tree modelling can provide an improved understanding of farmer decision-making. Results show that four decision trees were necessary to understand decisions made by a non-random sample of farmers in Hawke's Bay. Each tree specifies elimination criteria, cost and benefit calculations, reasons to plant and constraints that prevent farmers from planting. The results are interpreted in the light of the New Zealand literature and some recommendations for future research are made.

Keywords: Farmers, decision-making, trees, Hawke's Bay.

Introduction
The development and encouragement of forestry in New Zealand has been a long-standing and general policy aim for many groups, and achieving this aim requires giving attention to many dimensions of forestry. One such dimension includes farm foresters and, in particular, their attitudes and decision-making relating to planting trees. While the recent increase in planting includes farmers, companies and other landowners (e.g., smallholders), it is likely that farmers are an important component of this increase and research on the decision-making of farmers is still relevant. Research to date has considered farmer decision-making, but not necessarily in ways that fully enlighten the topic. In this article, the relevant international and New Zealand literature is reviewed to highlight the main findings, and to show that it has emphasised attitudes, motivations or factors influencing tree planting decision-making but has not analysed in detail decision-making itself. The ethnographic decision tree model approach (Gladwin, 1989b) then is introduced and applied to a sample of farmers in Hawke's Bay. The results highlight the subtleties of farmers' decision-making and identify precisely the reasons for, and constraints on, tree planting. It is argued that decision trees broaden our understanding of the actual decision-making process relating to tree planting. While the results of this study were obtained in 1992, they still provide some insight into farmer decision-making, insights which are likely to be very relevant to the present-day situation.

Attitudes to trees and reasons for planting
Farmers' attitudes towards trees are well studied. In British research, for example, Sidwell (1989) surveyed 708 farmers in Scotland and Northern England to find that half of the farmers had a positive view of trees, valuing their shelter and amenity benefits. Scambler (1989), interviewed 36 farmers in southern Scotland to find that the majority had little interest in forestry, and that the rate of adoption of forestry on farms would be limited. Other researchers have moved beyond attitudes and examined forestry decision-making and motivation more closely. Concerning diversion of agricultural land to forestry, Kellener and O'Hara surveyed 144 farmers in the north west of the Irish Republic to assess attitudes to European Commission pre-pension proposals. Most (65 per cent) were against the idea of taking land out of farming. In that research understanding of decision-making was guided by understanding attitudes and motivations. Similarly, Gasson (1988) described the factors that influenced farmers' responses to policies to encourage conservation, and Potter and Gasson (1988) asked farmers to state the minimum sum needed to persuade them to enrol in conservation schemes. Riihinen (1970) studied forestry decision-making in Finland and found that it was influenced by attitudes and cultural variables, while Jones and Price (1985) found that protection from elements was an important tree-planting motivation for farmers in Costa Rica. These examples are typical of approaches to farmers' decision-making but they focus on attitudes, motivations or factors influencing the decision, not the decision itself. The same pattern occurs in the New Zealand literature.

The main focus of the New Zealand literature has been on attitudes to forestry and, more specifically, on reasons for planting or not planting trees. Most of the work has been based on survey analysis where lists of reasons were presented to farmers and they indicated which ones were relevant to them. Farmers typically indicated more than one reason. In an early national study, Frost (1974) found that the main reasons for planting included: shelter (50%), wood for farm use (51%), best land use (48%), direct financial gain (40%) and beautification (39%). A later study (Smaller and Meister, 1983) focused on reasons for not planting within the Wellington conservancy, and they found that the main reason was the uncertain financial returns. In another study of 25 farmers in a high-country locality, Murray (1986) found that one-half thought that the economics of forestry were favourable, while an equal proportion did not plant because of lack of finance. Shelter was given as the main reason for investing in forestry. Constraints of finance were also identified by Enevoldsen (1990) interviewing farmers near Rotorua.

National surveys of farmers in 1984 and 1986 continued to provide lists of reasons for planting or not planting. Pryde and McCartin (1984) found that the main reasons for planting were: provision of shelter (46%), best land use (20%) and beautification (13%). The main reasons for not planting were: takes land out of grazing (49%), lack of money (17%) and inadequate return on investment (10%). Morey (1988) analysed the results of the 1986 national survey to show the degree of importance for each of eight different uses for forest trees on farms. Highest scores were given to shelter, landscape and aesthetic benefits, best land use and erosion control. For the ten reasons for not planting, highest scores were given to taking land out of agriculture and horticulture, and inadequate return. These surveys consistently showed that New Zealand farmers in the mid 1980s were motivated to plant trees mostly for shelter and then for best land use and aesthetic benefits. Income or profit was ranked low or seen as of neutral importance. The important reasons for not planting were the fact that forestry takes land out of production, lack of money and inadequate return on investment.

The survey-based approach to decision-making highlights reasons for planting and constraints to planting trees. The surveys have the advantage of indicating precisely the motivational characteristics of farmers and the proportions of these motivations among the population of farmers. However, the listing of reasons,

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or the identification of the main reason, overlooks some of the subtleties of decision-making itself. Less frequently mentioned reasons may be decisive factors for some farmers, and these reasons tend to be overlooked when attention is given to the most frequent reason, or the reason with the highest importance score. Further, there may be specific combinations of beliefs and reasons which need to be attended to before decision-making is fully understood. Finally, some reasons given importance by farmers in a survey of decision-making may not be essential elements of the decision to plant trees, or not plant trees. That is to say, farmers' stated attitudes may not be used by farmers as actual decision criteria: their survey response may reflect what seems most rational after a decision has been made. The following results of a 'tree' analysis of farmers' tree-planting decision-making illustrates the advantage of the method over other approaches by identifying precisely the key elements of decision-making and showing their relationship to each other.

Method

This New Zealand study used interviews with 25 farmers to build and refine decision 'trees' for farmers' decisions to plant trees, or not to plant trees. Farmers in the Hawke's Bay province of the North Island of New Zealand were interviewed during March and April of 1992. Hawke's Bay is a province with a wide range of farm types, such as sheep and cattle grazing or horticultural production, and a variety of landforms. The climate and geography mean that trees can grow well. Tree species typically grown were *Pinus radiata*, other conifers, and a variety of hardwoods (e.g., *Acacia* spp., poplars, willows). Farmers were selected with the help of a local Ministry of Agriculture and Fisheries official and chosen to represent the variety of physical features and rainfall regions. This is known as theoretical sampling (Glaser and Strauss, 1962) where the objective is to select a variety of cases to reflect the possible influence of relevant variables on the topic in question. In this way the essential elements of decision-making are identified but not their frequency in the population. This sampling is similar to that which would be used by forest ecologists seeking to identify new plant associations by visiting places where relevant causal variables are manifest, rather than using a random sample of locations within the study area. Hawke's Bay is not representative of New Zealand, so the results of this study are directly relevant only to this region. Indirectly, however, the results indicate important elements of decision-making which are likely to occur for farmers in other regions.

Interviews took place on the farms and started with clarification of intended or recent tree planting. Farmers who were planting trees were asked why they planted and what constrained them from planting. Farmers not planting were asked about their attitudes to woodlots, shelterbelts, agroforestry (wide-spaced trees over pasture used for grazing) and poplars and willows. The interviews were unstructured and few direct questions were asked, except to encourage explanation. Farmers spoke freely to express their views on trees and most held these views strongly. A checklist of key questions was used at the end of the interview to ensure that key topics were covered. All interviews were tape recorded and detailed notes of interviews were made during the interviews.

Each interview was examined by reference to the detailed notes and by elaborating these notes, where necessary, by 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. This summary provided easy access to the main points of each farmer's views on trees.

Both the summary notes and the interview transcripts were used to identify decision criteria, key factors and other constraints in order to build up the decision trees as specified by Gladwin (1989a, 1989b). The decision trees themselves evolved slowly as each interview was analysed. Early models were revised to make them consistent with later interviews in a process that was difficult and time-consuming. Each additional interview had to be integrated while at the same time developing, maintaining or modifying existing themes. Interviews were repeatedly re-examined to ensure that the developing decision tree was consistent with them. Some themes or elements originally considered important were discarded or modified in the light of integrating later interviews. At all times the developing decision trees had to fit the data or the interviews.

Gladwin (1989b) 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 covered many aspects of decision-making so that each provided sufficient data to elaborate or test the decision criteria. The completed tree is a model of decision-making. Each farmer passed through a series of criteria which was true or false and reached a point on the periphery which stated that he or she will or will not plant trees. The sequence of criteria which was true for them identifies the reasons for their actions. While particular cases were used to build the decision tree, once built it can predict outcomes for other farmers once the criteria which are true for them are known.

Results

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, and this study found that farmers could plant trees for woodlots, shelterbelts or agroforestry. In addition, poplar or willow poles could be planted for erosion control, shade or drought fodder. While the original intention was to describe one decision tree, analysis of the interviews showed that more than one decision was involved and four separate decision trees were developed for each type of planting.

The models have some common features and these are considered first before going on to examine each specific model. The models show that farmers must pass a set of elimination criteria before going on to consider planting trees. If any one of these criteria was relevant the farmer would not consider the issue of planting trees. For example, if the farmer believed that trees would not grow on his or her land, then later parts of the model were irrelevant and the farmer exited early on in the model. The order of these elimination criteria is not particularly important. In this research the order reflects logical priority whereby apparently more fundamental criteria, or more extreme anti-tree cases, are eliminated first. The models then identify important decision criteria regarding tree planting, and typically this introduces some judgement about cost and financial returns. After this the models divide farmers into different groups and more specific reasons for planting are included. 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 criteria, reasons for or against planting, and constraints that may apply, are common to each of the four decision tree models described here.

The Decision to Plant Woodlot Trees

Figure 1 shows a tree model for the decision to plant woodlot trees or not plant woodlot trees. The decision tree includes 13 numbered criteria connected by arrows showing 'yes' or 'no' conditions. The numbers in brackets show the number of farmers for whom the criterion was true or false. There were three criteria which, if applicable, meant that the farmer eliminated him

or herself from the decision tree. Farmers would not consider planting a woodlot if they believed that their land was unsuited to woodlot trees (criterion 1), if they had harvested trees, experienced low income and been put off woodlot trees (criteria 2 and 3), or if they have sufficient woodlot trees already (criterion 4). If any one of these criteria was applicable then the farmers did not have to make a further assessment about planting woodlot trees.

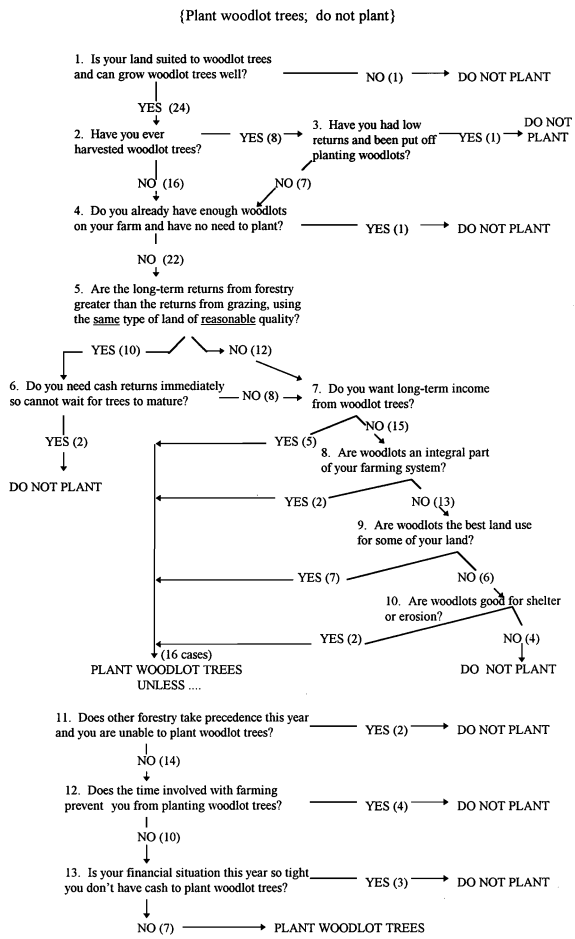
Farmers who did not leave the decision tree went on to the key decision about the assessment of the long-term returns from forestry compared to grazing (criterion 5). The issue was presented to farmers as a hypothetical one concerning well-managed trees on land of reasonable quality. This decision can in principle be based on rigorous accounting techniques, but for many farmers this approach was not suitable and they made a decision as a best guess. Farmers were allowed to make this decision themselves, understanding that different people have different views on this hypothetical issue. In only one case was the farmer not able to make a decision and the grazing option seemed the best reflection of his position. There was a basic division in the tree at criterion 5 reflecting the different assessment of forestry versus grazing returns. Broadly speaking, there was a division here between forestry-oriented farmers and graziers. The decision tree next shows the decision criteria below this comparison of forestry and grazing returns.

The 10 farmers who agreed with criterion 5 did not all plant woodlot trees because two needed cash returns immediately and could not wait for trees to mature (criterion 6). The remaining eight forestry-oriented farmers then joined with the graziers to consider long-term income (criterion 7). Of the eight forestry-oriented farmers there were five who agreed with criterion 7. The remaining 15 farmers went on to consider criterion 8, and there were two (forestry-oriented) farmers who said that their farming and forestry were a closely-integrated activity. Woodlots as the best land use for some of the farm (criterion 9) specified another motivation for planting woodlots that was true for seven of the graziers. Last, woodlots as the best land use for some of the farm (criterion 10) was the remaining motivation, selected by one forestry-oriented farmer and one grazier.

Finally, there were the constraints to planting for those farmers who had decided to plant woodlot trees. For the farmers who had a need or reason to plant woodlot trees it was not true that they necessarily planted trees because the decision was subject to a number of constraints. In two cases the farmers had other forestry activities which took precedence (criterion 11) and they did not plant trees. Presumably other forestry activity such as silviculture could also be a constraint but this was not mentioned by any farmers. Another four farmers had no time to plant in that year, given their present system of farming or the stage of farm development (criterion 12). These farmers were likely to be committed solely to farming for the next few years. Finally, three farmers did not have cash available for that particular year and could not afford the costs associated with planting (criterion 13).

Results from the non-random sample of 25 cases used to develop this woodlot decision tree model show that three farmers were eliminated early on in the decision tree, and they did not consider planting woodlot trees. The remaining 22 farmers divided fairly evenly over the question of financial returns from forestry versus grazing with 10 farmers favouring forestry and 12 farmers favouring grazing. A total of six farmers exited after this decision criterion because they wanted cash or because they had no other reason to plant. This meant that a total of nine farmers (3 + 6 or 36 per cent of the total sample) decided not to plant woodlot trees and the remaining 16 (64 per cent) decided to plant woodlot trees. For these remaining 16 cases the numbers in Figure 1 show that for those who favoured forestry returns, the financial aspect was important in their reasoning behind planting woodlot trees: of the eight cases disagreeing with criterion 5, five

Figure 1: Tree Model of the Decision to Plant Woodlot Trees



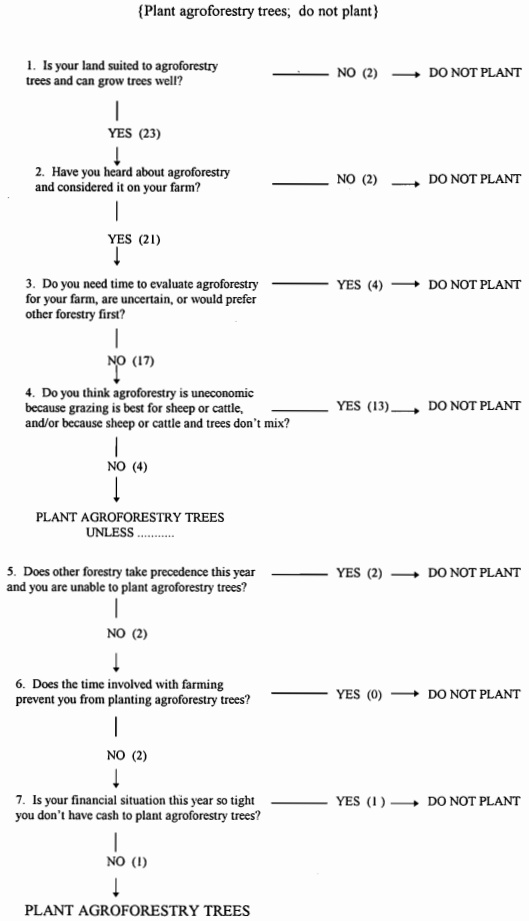
chose the financial criterion (number 6). For those farmers favouring grazing returns, most of them (seven out of eight) selected the best land-use criterion. However, despite the relatively large proportion favourably disposed to planting woodlot trees (16 cases out of 25) over one-half faced a constraint: two (or 13 per cent) had other forestry taking precedence, four (or 25 per cent) had no time and three (19 per cent) had no cash. Together these nine cases did not plant because of a constraint, even though they had decided to plant trees.

The Decision to Plant Agroforestry Trees

Figure 2 shows the tree model for the decision to plant trees as agroforestry. In this study agroforestry was defined as wide-spaced timber trees on land of good or reasonable quality with pasture beneath the trees for sheep and cattle grazing. This definition reflected the common understanding that farmers had, at that time, of agroforestry, a definition popularised by Neil Barr and publicised in farmers' magazines. For most of the farmers interviewed agroforestry was thought of as using pines only. Figure 2 shows the elimination criteria and reasons for planting agroforestry trees. As in Figure 1 there was the issue of whether trees could grow, and there were two farmers who made a negative assessment. Two farmers had not heard about agroforestry (criterion 2) and for this reason did not consider it on their farm. This criterion was difficult to appraise because farmers are unlikely to answer negatively, even if they have not heard about agroforestry. In the course of interviewing it was possible to make an indirect assessment of their level of awareness of agroforestry. 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. Criterion 4 related to the economic assessment of agroforestry. There were 13 farmers 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 only and two pointed out that stock and trees did not mix, saying that there was potential for stock poisoning and lack of grass growth under trees. The outcome of putting 25 cases through the first part of the decision tree was a total of four cases (or 16 per cent) who would plant agroforestry trees unless they faced a constraint to planting. The three constraints were the same as for Figure 1.

Figure 2: Tree Model of the Decision to Plant Agroforestry Trees



Decision trees were also developed for the decision to plant shelterbelts and the decision to plant poplar and willow poles (see Fairweather (1992)). These decision trees have a similar structure to those illustrated in Figures 1 and 2. There were three or four elimination criteria, some considerations of costs and benefits, a number of possible reasons to plant and, finally, the same three constraints that prevented farmers planting even if they had a reason to plant.

Discussion and Conclusion

Presenting a detailed explanation of farmers' decision-making processes is a unique contribution to forestry research. The existing literature presents results which typically are aggregated for all farmers studied and overlook variations within the samples. The results presented here clearly show particular combinations of reasons for and against planting. For example, for the woodlot decision there were four basic groups. The first group did not even consider planting woodlot trees because they believed trees would not grow, they had been put off or they already had enough woodlots. The second group were graziers who had no reason to plant. The third group were graziers who planted woodlots typically because they considered that it was a better land use on some of their land. The fourth group saw forestry as providing better returns than grazing and for most of this group the financial returns were the main factor in their decision to plant. While the results presented here show the numbers of farmers who gave particular reasons, the important result is the overall structure of the decision tree. Random sample surveying would be needed to assess frequencies of different groups in the population.

The four decision trees explicate details of the decision-making process that occurs for four types of planting. Research to date has considered tree planting as though it were oriented by one purpose. Four types of planting have to be considered separately in any attempt to understand tree-planting decision-making, and research that focuses on attitudes to trees in general may overlook how they will differ, depending on the purpose and type of planting. However, the results presented here do corroborate some of the earlier findings. For example, New Zealand research has shown that lack of time and lack of money have been frequently cited by farmers as the main reason for not planting trees, and these were 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 (criterion 5), but it is not uniformly assessed by all farmers.

The four decision trees indicate that economic assessments were important in all decisions even if the assessments of the long-term returns from forestry were either positive or negative. In contrast, the literature has shown that non-economic factors have been important in farmers' decisions to plant trees, although it has reported that farmers have said that lack of money was a major constraint to planting. It may be that the earlier surveys have underemphasised the role that economic assessments play in farmers' attitudes to trees. It is quite likely that past survey methods have not allowed farmers' views on profitability to be properly understood. The ethnographic interviewing used in this study is a better way to assess farmers' viewpoints. All farmers, explicitly or implicitly, weighed up forestry and grazing in financial terms. However, it may be that the results from this research reflect genuine changes in farmers' thinking and that they have become in recent years more concerned with economic and financial matters. Farmers in New Zealand have had to reappraise their land-use decision in the absence of subsidies supporting particular land uses. There is clear evidence of changes in land use (Fairweather, 1992) and there is evidence of improving forestry returns compared to pastoral returns (Levack, 1991). It is likely then that farmers in recent years have been considering tree-planting alternatives but are having to appraise the decision carefully on economic grounds. Perhaps also there has been a long-term process at work whereby there is increasing recognition of forestry generally. 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. Further, increasing financial awareness is being matched by environmental awareness. In March 1988 Cyclone Bola caused massive damage in Gisborne, thereby reminding farmers in Hawke's Bay, and elsewhere, of the importance of trees on farms. The issue of possible change in attitudes can only be addressed by way of larger surveys and the indications here are only suggestive.

When compared to the existing research, the results show up a different emphasis to aesthetic reasons. The New Zealand research to date has shown clearly that farmers have rated aesthetic reasons as important in their attitudes towards trees. The

results reported here in the four decision trees do not give any recognition to aesthetic reasons. However, aesthetic reasons were emphasised by farmers during the interviews and many said that the aesthetic benefits from trees (i.e., for beauty or for improving their work environment) were important. However, 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 played no part in the decision tree. If this interpretation of farmers is valid then it means that while aesthetics are a part of farmers' decision-making it is not a decisive factor. Perhaps when farmers plant trees for which 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 to which farmers can point 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.

The process of rationalisation referred to above 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 were viewed negatively because they promoted livestock disease, caused abortions, soured the ground or caused endless maintenance problems. For farmers who liked trees they were viewed positively because they provided 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, it can be stated that the more enthusiastic farmers were about trees then the more reasons they gave for planting trees.

The decision trees highlight constraints that prevented farmers who were favourably disposed to forestry from planting trees. This includes: need cash returns now (criterion 6), other forestry takes precedence (criterion 11), lack of time (criterion 12) or lack of money (criterion 13). Where other forestry takes precedence, the constraint is perhaps not so crucial, because these farmers have already planted trees or will plant trees in future. The remaining constraints are more interesting because they relate to lack of time and/or money. Forestry joint ventures are one way that these constraints can be overcome. However, few farmers mentioned joint ventures, and of those that did most were reluctant to use outside capital because they did not like the associated lack of control.

This article has presented results of research that improves our understanding of farmer decision-making regarding trees. Two decision trees were described and each identified key elements of farmers' decision-making. Future research needs to assess whether farmers' decision-making has changed since 1992, and to study farmers' decision-making in other regions to assess the relevance for these findings elsewhere. Research could focus on other tree-planting groups such as companies or smallholders and it could focus on a particular aspect of a decision tree, for example, the basis of the assessment of costs and benefits of forestry versus agriculture.

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NZ Forest Owners' Association and NZ Farm Forestry Association
Forestry Briefing – Election '96

The two Associations have jointly prepared a guide for political parties. The guide outlines issues and provides recommendations. The major issues and some of the recommendations are reproduced here.

Political and Economic Environment

- No change in basic tax treatment of forestry
- Privatisation of remaining commercial State forests
- Continued consultation with forest growers over transportation pricing issues

Sustainability

- Ensure "environmental effect" provisions of the RMA are consistently applied
- Encourage local government to recognise favourable outcomes from plantation forestry as an acceptable land use
- Streamline application and implementation procedures for the Forests Amendment Act
- Involve forest growers in discussions about green-house gas reduction and sustainable forestry management principles

Health, Safety, Education and Training

- Greater self-regulation for HASE through industry Codes of Practice
- Continuing partnership between Government and industry to underpin education and training

Valuation of Forest Land

- Application of clear valuation principles for forested land
- Neutral rating policies by local government